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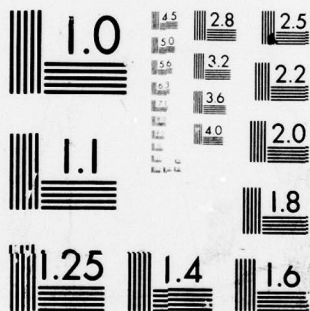
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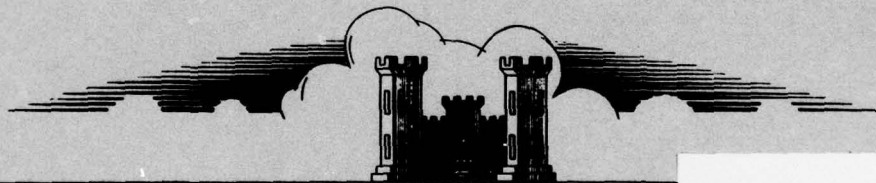
OHIO RIVER BASIN
FOUR-MILE RUN, WESTMORELAND COUNTY

PENNSYLVANIA
FOUR-MILE RUN DAM

NDS I.D. No. PA - 00457
PENNDER I.D. No. 65 - 126

LEVEL

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



ORIGINAL CONTAINS COLOR PLATES: ALL DDC
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DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY
GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146
AUGUST 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Four Mile Run Dam: NDI I.D. No. PA-00457

Owner: Pennsylvania Fish Commission
State Located: Pennsylvania (PennDER I.D. No. 65-126)
County Located: Westmoreland
Stream: Four Mile Run
Inspection Date: 20 June 1979
Inspection Team: GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

The visual inspection, operational history, and hydrologic/hydraulic analysis indicate the facility is in good condition.

The size classification of the facility is intermediate and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store about 56 percent of the PMF prior to embankment overtopping. Consequently, the spillway is assessed as being inadequate, but not seriously inadequate.

Deficiencies noted by the inspection team included cracking within the outlet conduit, an inadequate emergency warning system, minor seepage to the right of the spillway, and inadequate riprap protection along the right sidewall of the spillway approach channel.

It is recommended that the owner:

- (a) Immediately fill and seal all cracks within the interior of the outlet conduit.
- (b) Specifically address the seepage condition observed to the right of the spillway in all future inspections and note any turbidity or changes in the rate of flow. → over

→ (c) Re-evaluate and revise the present standard flood emergency procedures in accordance with, but not limited to, the following items:

(1) Include a definite procedure of notifying downstream residents of a possible emergency.

(2) Provide for an alternate means of communication in the event telephone lines become inoperative.

(3) Provide for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

(d) Provide additional riprap protection along the right sidewall of the spillway approach channel. ↙

⑥ National Dam Inspection Program.
Four-Mile Run Dam (NDS I.D. Number PA-77457,
PennDer I.D. Number 65-126), Ohio River
Basin, Four-Mile Run, Westmoreland County,
Pennsylvania. Phase I Inspection Report,

⑮ DACW 31-79-C-0013

⑩ Bernard M. / Mihalcin

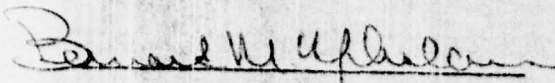
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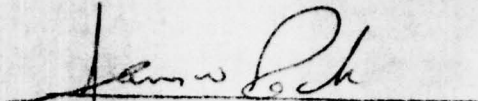
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GAI Consultants, Inc.

Approved by:



Bernard M. Mihalcin, P. E.



JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



Date 27 August 1979

Date 18 Sep 79



OVERVIEW PHOTOGRAPH

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
FOUR MILE RUN DAM
NDI# PA-457, PENNDER# 65-126

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Four Mile Run Dam is a zoned earth embankment approximately 32 feet high and 520 feet long (including spillway). The facility is provided with a rectangular, concrete chute channel spillway and plunge pool located at the right abutment. The spillway crest consists of a trapezoidal-shaped weir structure 74 feet in length. The outlet works consists of a 4-foot square reinforced concrete culvert that discharges at the downstream embankment toe. Flow through the culvert is regulated via stop logs set within a concrete vertical riser positioned along the upstream embankment face.

b. Location. Four Mile Run Dam is located on Four Mile Run in Donegal Township, Westmoreland County, Pennsylvania, about 3 miles northeast of Donegal and Pennsylvania Turnpike Interchange 9. The dam and reservoir (locally known as Donegal Lake) are contained within the Mammoth, Pennsylvania, 7.5 minute U.S.G.S. topographic quadrangle. The coordinates of the dam are N40° 06' and W79° 25' (see Appendix G).

c. Size Classification. Intermediate (32 feet high; 1,650 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Pennsylvania Fish Commission
P. O. Box 1673
Harrisburg, Pennsylvania 17120

f. Purpose. Public fishing.

g. Historical Data. Four Mile Run Dam was completed in 1967. Both the design and construction of the facility were undertaken by Pennsylvania Fish Commission (PFC) staff. Periodic progress reports were issued by the PFC and the construction site was frequently visited by PennDER personnel. No major problems were encountered during construction and the facility has operated virtually problem-free since completion.

1.3 Pertinent Data.

a. Drainage Area (square miles). 5.9

b. Discharge at Dam Site.

Discharge Capacity of the Outlet Conduits - Discharge curves are not available. PFC calculations indicate the maximum discharge capacity at top of dam is 220 cfs.

Discharge Capacity of Spillway at Maximum Pool \approx 4830 cfs (see Appendix C, Sheet 9).

c. Elevation (feet above mean sea level). The following elevations were obtained from design drawings and through field measurements based on the elevation of the spillway crest at 1458.0 feet.

Top of Dam	1465 (design)
	1464.8 (field)
Maximum Design Pool	Not known
Maximum Pool of Record	Not known
Normal Pool	1458
Spillway Crest	1458
Upstream Inlet Invert	1433.5
Downstream Outlet Invert	1433
Streambed at Dam Centerline	1433
Maximum Tailwater	Not known

d. Reservoir Length (miles).

Top of Dam	1.4
Normal Pool	1.2

e. Storage (acre-feet).

Top of Dam	1650
Normal Pool	900
Design Surcharge	Not known

f. Reservoir Surface (acres).

Top of Dam	132
Normal Pool	90
Maximum Design Pool	Not known

g. Dam.

Type	Zoned earth.
Length	520 feet
Height	32 feet (field measured; crest to downstream toe at outlet conduit).
Top Width	16 feet
Upstream Slope	3H:1V
Downstream Slope	2.5H:1V
Zoning	Embankment constructed with four (4) zones: selected impervious fill; class "A" fill; class "B" fill; selected pervious material. See notes on Figure 6 for description of zone materials.
Cutoff	12-foot wide trench excavated to rock and backfilled with selected impervious fill.
Grout Curtain	None indicated.

h. Diversion and Regulating Tunnels.

None.

i. Spillway.

Type

Rectangular concrete chute channel spillway with discharges controlled by a trapezoidal-shaped concrete weir structure.

Crest Elevation

1458

Crest Length

74 feet

j. Outlet Conduit.

Type

4-foot square reinforced concrete culvert.

Length

180 feet (inlet to outlet).

Closure and Regulating Facilities

Flow through outlet is controlled via removable stop logs set in grooves within a reinforced concrete control tower riser.

Access

Control tower accessible from embankment crest.

SECTION 2 ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No formal design reports are available. Design calculations are contained in Pennsylvania Fish Commission files along with design drawings, test boring results, and contract specifications. In addition, construction progress reports and photographs are available from PennDER files.

b. Design Features.

1. Embankment. The contract drawings indicate the embankment is a zoned earth structure 32 feet high and 520 feet in length. The embankment is constructed with a core and cutoff trench to rock containing selected impervious fill and upstream and downstream structural zones of semi-pervious and pervious fill (see Figure 6). The dam is designed with side slopes of 3H:1V on the upstream side and 2.5H:1V on the downstream side. The crest width is 16 feet. The upstream slope is protected by 18 inches of dumped riprap on 12 inches of crushed stone. The riprap extends 3 feet above and below the flow line. The embankment is also provided with a drainage system along its downstream toe.

2. Appurtenant Structures.

a) Spillway. The spillway at Four Mile Run Dam is a reinforced concrete chute channel with a trap-ezoidal-shaped overflow weir located at the right abutment. The chute is 127 feet long from the toe of the weir to the stilling basin. The crest length of the overflow weir measures 74 feet and is flanked by vertical concrete wingwalls that provide 7 feet of freeboard (see Figures 3 and 8).

b) Outlet Works. The outlet works consists of a reinforced concrete riser and 4-foot square horizontal box culvert which discharges at the downstream embankment toe (see Figure 7 and Photograph 6). Flow through the outlet is controlled via removable stop logs set in grooves within the riser (see Photograph 5).

c. Specific Design Data and Criteria. Calculations contained in Pennsylvania Fish Commission files indicate that the embankment and spillway design were based on pro-

cedures and guidelines contained in the text, "Design of Small Dams" by the U. S. Bureau of Reclamation, and "Handbook of Applied Hydraulics," by King and Davis. The spillway was sized to meet the requirements of the Pennsylvania "C" Curve.

Available calculations deal primarily with spillway details and concrete design. No specific soils data, seepage, or stability calculations are available.

2.2 Construction Records.

Design drawings, contract specifications, construction progress reports, and construction photographs are available from PennDER and Pennsylvania Fish Commission files. No field testing records are available.

2.3 Operational Records.

No records of the day-to-day operation of this facility are maintained.

2.4 Other Investigations.

No formal investigations have been performed on this facility subsequent to its construction.

2.5 Evaluation.

Engineering data in the form of drawings, specifications, miscellaneous calculations, correspondence, and construction photographs are available from PennDER and Pennsylvania Fish Commission files. The data indicate the facility was designed and constructed in accordance with accepted engineering criteria and are considered adequate to make a reasonable Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests the dam and its appurtenances are currently in good condition.

b. Embankment. Observations made during the visual inspection indicate the embankment is in good condition. Minor seepage was noted along the embankment toe about 15 feet to the right of the spillway. The wet area created by the seepage is 25 feet wide and roughly confined to a narrow strip 3 to 8 feet below normal pool. The area is drained by a 4-inch diameter perforated PVC pipe laid in a trench and covered with crushed stone that discharges below the spillway plunge pool. Otherwise, no evidence of sloughing, erosion, animal burrows, or general maintenance neglect were observed.

c. Appurtenant Structures.

1. Spillway. The visual inspection revealed the spillway is in good condition. Several minor cracks were observed along the concrete wingwalls which were filled and sealed with epoxy. The approach channel sidewall at the right abutment is not adequately protected with riprap and is subject to erosion.

2. Outlet Works. The outlet works are in good condition. The 4-foot square box culvert was entered and several diagonal cracks were observed in the culvert walls in the segment located about 10 to 20 feet from the control tower riser. No signs of concrete deterioration were observed on the interior or exterior surfaces of the control tower riser. The stop logs were in place and performing as designed.

d. Reservoir Area. The general area surrounding Donegal Lake contains gentle to moderate slopes comprised of both pasture and woodlands. The lake is used for public fishing and, consequently, portions of the shoreline have been equipped with parking, fishing, and boating facilities.

e. Downstream Channel. The channel downstream from Four Mile Run Dam is characterized as a narrow, mostly wooded valley with steep confining slopes. Two permanent dwellings are located about 1/2-mile downstream from the embankment and close to the stream (estimated population = 6

to 8). Further downstream the valley begins to broaden. A private park, equipped with various picnic, swimming, and recreational facilities is located in the floodplain about 2-1/2 miles downstream along PA Route 130. Consequently, the hazard classification for this facility is considered "high".

3.2 Evaluation.

The overall condition of the facility is considered good. Drains have been installed to control the seepage observed to the right of the spillway; nevertheless, the condition should be addressed in future inspections. Specifically, turbidity or changes in the rate of seepage flow should be noted and evaluated regularly. Cracks within the outlet conduit walls (and possibly floor) should be identified and sealed. Also, the unprotected approach channel sidewall should be lined with a layer of riprap.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Normal Operational Procedures.

Four Mile Run Dam is essentially a self-regulating facility. Excess inflows are automatically discharged through the spillway located at the right abutment. The outlet conduit is generally used only for the purpose of drawing down the reservoir with flow being manually controlled via stop logs set in grooves within the control tower riser. The top stop log is set 1/2-foot above normal pool such that under high flows the outlet conduit begins to discharge automatically.

The Pennsylvania Fish Commission is currently developing a formal "Operation and Maintenance Manual" for Four Mile Run Dam that will establish both routine and emergency operating procedures.

4.2 Maintenance of Dam.

Currently, maintenance of the dam is performed informally on an as-needed basis. The proposed "Operation and Maintenance Manual" will establish formal procedures and guidelines for all maintenance work. The manual will also include a formal maintenance checklist covering the entire facility.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

Emergency plans are currently being developed for all Pennsylvania Fish Commission dams. A standard format is being incorporated into the "Operation and Maintenance Manual". A review of the procedures indicates possible deficiencies in the plan which include the lack of:

a. A definite procedure to notify downstream residents of a possible emergency situation.

b. Provisions for an alternative means of communication in the event telephone lines become inoperative.

c. Provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

4.5 Evaluation.

A formal manual establishing operation and maintenance procedures is currently being developed by the Pennsylvania Fish Commission specifically for this facility. The manual will also contain procedures for operation of the facility during a flood emergency; however, consideration should be given to modifying any emergency plan in accordance with, but not limited to, the items listed in Section 4.4, herein.

SECTION 5 HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

Calculations contained in Pennsylvania Fish Commission files indicate that the hydrologic and hydraulic design of Four Mile Run Dam was based on the Pennsylvania "C" Curve along with procedures and guidelines contained in the texts, "Design of Small Dams" by the U. S. Bureau of Reclamation, and "Handbook of Applied Hydraulics" by King and Davis.

The data indicate that the spillway design flow from the "C" Curve is 5244 CFS and that the maximum combined spillway and outlet discharge is 5456 CFS.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharges are not available.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the spillway and outlet system would not perform satisfactorily during a flood event within the limits of its design capacity.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix C.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Four Mile Run Dam is the Probable Maximum Flood (PMF). This classification is

based on the relative size of the dam (intermediate) and the potential hazard of dam failure to downstream developments (high).

b. Results of Analysis. Four Mile Run Dam was evaluated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of 1458.0 feet, with the spillway discharging freely. However, the normally discharging outlet conduit was assumed to be non-functional for the purpose of analysis. In any event, the capacity of the outlet is such that it would not significantly increase the discharge capabilities of the total facility. The design reservoir surface area curve was available and used in the analysis. The spillway is a concrete chute channel with discharges controlled by a concrete trapezoidal-shaped weir structure. Since preliminary computations indicated that this weir structure could hydraulically perform in a manner similar to that of an ogee-crested weir, ogee relationships were assumed in the analysis. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix C.

Overtopping analysis (using the modified HEC-1 computer program) indicated that the discharge/storage capacity of Four Mile Run Dam can accommodate only about 56 percent of the PMF (SDF) prior to overtopping of the embankment (Appendix C, Summary Input/Output Sheets, Sheet D). The peak PMF inflow of approximately 9900 cfs was somewhat attenuated by the discharge/storage capabilities of the dam and reservoir such that the resulting peak PMF outflow was about 9580 cfs (Summary Input/Output Sheets, Sheets B and C). Under the PMF, the embankment was overtopped for approximately 6.8 hours, with a maximum depth of inundation equal to about 1.9 feet above the low top of dam elevation of 1464.8 feet (Summary Input/Output Sheets, Sheet D).

5.6 Spillway Adequacy.

Although Four Mile Run Dam cannot accommodate its SDF (the PMF), the possible downstream consequences of embankment failure due to overtopping were not evaluated. Breaching analysis of the dam was not performed in accordance with ETL-1110-2-234, since the facility can safely pass a flood of at least 1/2 PMF magnitude. Since Four Mile Run Dam cannot accommodate a PMF-size flood, its spillway is considered to be inadequate, but not seriously inadequate.

SECTION 6 EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appears to be in good condition. The facility is well maintained while no evidence of sloughing, erosion, excess settlements, or animal burrows were observed. Seepage was detected to the right of the spillway; however, drains have been installed and appear to be functioning properly. Presently, the seepage is not considered a threat to the structural stability of the embankment; nevertheless, it should be specifically addressed in future inspections.

b. Appurtenant Structures.

1. Spillway. The spillway appears to be structurally well designed and currently in good condition. Consideration should be given to providing additional riprap protection to the right sidewall of the spillway approach channel.

2. Outlet Works. The outlet works, which include both the control tower riser and 4-foot square discharge culvert, are considered to be in good condition. Cracks observed within the interior of the culvert appear to be the result of settlement of the compacted fill beneath the conduit. The cracks should be identified (mapped), sealed, and specifically addressed in future inspections.

6.2 Design and Construction Techniques.

No formal reports are available. Some design calculations are contained in Pennsylvania Fish Commission files which indicate a majority of the design was based on procedures and guidelines contained in the reference, "Design of Small Dams" by the U. S. Bureau of Reclamation. Based on the information available, the facility appears to be adequately designed in accordance with generally accepted modern engineering practices. The concept of founding the outlet conduit on the compacted core trench backfill, which is variable in depth and subject to consolidation, is questionable, especially in light of the observed structural cracking within the conduit. A review of available correspondence, contained in PennDER and Pennsylvania Fish Commission files, reveals nothing that would create suspicion as to the applied construction techniques.

6.3 Past Performance.

According to Pennsylvania Fish Commission personnel, the facility has operated virtually problem-free throughout its 12-year history.

6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1 and it is thought that the static stability of the structure is sufficient to withstand minor earthquake induced dynamic forces. However, no calculations and/or investigations were performed to confirm this belief.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, operational history, and hydrologic/hydraulic analysis indicate the facility is in good condition.

The size classification of the facility is intermediate and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store about 56 percent of the PMF prior to embankment overtopping. Consequently, the spillway is assessed as being inadequate, but not seriously inadequate.

Deficiencies noted by the inspection team included cracking within the outlet conduit, minor seepage to the right of the spillway, inadequate riprap protection along the right sidewall of the spillway approach channel, and an inadequate emergency warning system.

b. Adequacy of Information. The available data are considered sufficient to make a reasonable assessment of the facility.

c. Urgency. It is suggested that the recommendations listed below be implemented as soon as possible.

d. Necessity For Additional Investigations. No additional investigations are currently deemed necessary.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner:

a. Immediately fill and seal all cracks within the interior of the outlet conduit.

b. Specifically address the seepage condition observed to the right of the spillway in all future inspections and note any turbidity or changes in the rate of flow.

c. Re-evaluate and revise the present standard flood emergency procedures in accordance with, but not limited to,

the following items:

1. Include a definite procedure of notifying downstream residents of a possible emergency.
2. Provide for an alternate means of communication in the event telephone lines become inoperative.
3. Provide for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.
- d. Provide additional riprap protection along the right sidewall of the spillway approach channel.

APPENDIX A
CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM: Four Mile Run Dam
NDI#: PA-457 PENNDR#: 65-126

PAGE 1 OF 5

ITEM	REMARKS	NDI# PA - 457
PERSONS INTERVIEWED AND TITLE	Pennsylvania Fish Commission (PFC) Eugene Smith - Chief of Construction and Maintenance Dan O'Neill - Maintenance Superintendent Clyde Buell - District Two Facilities Manager Don Hyatt - District Waterways Patrolman (resides on site)	
REGIONAL VICINITY MAP	See Appendix G (U.S.G.S. 7.5 minute topographic quadrangle, Mammoth, Pennsylvania).	
CONSTRUCTION HISTORY	PFC designed and built facilities (E. Smith - resident construction engineer) PFC files contain pre-construction and construction photographs, monthly work records, concrete test records. No soils test taken.	
AVAILABLE DRAWINGS	Construction (contract) drawings - not as-built, but no deviations as per E. Smith.	
TYPICAL DAM SECTIONS	See Figures 4 and 6, Appendix F.	
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Figure 3, Appendix F. See Figure 7, Appendix F. None available	

ITEM	REMARKS	NDI# PA - 457
SPILLWAY: PLAN SECTION DETAILS	See Figure 8, Appendix F.	
OPERATING EQUIPMENT PLANS AND DETAILS	See Figure 7, Appendix F.	
DESIGN REPORTS	None available. Construction specifications contained in both PennDER and PFC files.	
GEOLOGY REPORTS	Test borings by F. T. Kitlinski (March 1954) in PFC files. (Permeability tests in soil and rock - no calcs included.)	
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	Hydraulic design data contained in PFC files. Limited hydrologic design data available. Stability or seepage analysis are not available.	
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	See "Geology Reports" (above).	

ENGINEERING DATA (CONTINUED)

PAGE 3 5

ITEM	REMARKS	NDI# PA - 457
BORROW SOURCES	Within reservoir. 36,000 CY embankment - from cost estimate contained in Penndder files.	
POST CONSTRUCTION DAM SURVEYS	None.	
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.	
HIGH POOL RECORDS	Probably June 1972. 2 to 3 feet over spillway according to PFC personnel. No formal records.	
MONITORING SYSTEMS	None.	
MODIFICATIONS	None.	

ENGINEERING DATA (CONTINUED)

PAGE 4 OF 5

ITEM	REMARKS	NDI#	PA	457
PRIOR ACCIDENTS OR FAILURES	None.			
MAINTENANCE: RECORDS MANUAL	Bi-weekly records from regular maintenance crew. Formal manual currently under development by PFC staff.			
OPERATION: RECORDS MANUAL	Recorded in PFC report on regular basis. Formal manual currently under development by PFC staff.			
OPERATIONAL PROCEDURES	Self-regulating. Reservoir drawn down about 6 feet every two years to kill off excess weed growth along shoreline.			
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	Being developed by PFC to be included in "Operation and Maintenance Manual." Presently, District Waterways Patrolman (Don Hyatt) resides on site adjacent the embankment.			
MISCELLANEOUS	PFC developing notebook for Clyde Buell which contains O&M manual and warning system for all dams in his district.			

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-457
PENN DER ID # 65-126
PAGE 5 OF 5

SIZE OF DRAINAGE AREA: 5.9 square miles
ELEVATION TOP NORMAL POOL: 1458 STORAGE CAPACITY: 900 acre feet
ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -
ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -
ELEVATION TOP DAM: 1464.8 STORAGE CAPACITY: 1650 acre-feet

SPILLWAY DATA

CREST ELEVATION: 1458
TYPE: Rectangular concrete channel with uncontrolled trapezoidal-shaped weir.
CREST LENGTH: 74 feet
CHANNEL LENGTH: 180 feet
SPILLOVER LOCATION: Right abutment
NUMBER AND TYPE OF GATES: None

OUTLET WORKS

TYPE: 4-foot square box culvert and control tower riser
LOCATION: Near embankment center
ENTRANCE INVERTS: 1433.5
EXIT INVERTS: 1433
EMERGENCY DRAWDOWN FACILITIES: Stop logs in control tower riser

HYDROMETEOROLOGICAL GAGES

TYPE: None
LOCATION: -
RECORDS: -

MAXIMUM NON-DAMAGING DISCHARGE: Not known

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

PAGE 1 OF 8

NAME OF DAM Four Mile Run Dam STATE Pennsylvania COUNTY Westmoreland

NDI# PA - 457 PENNDR# 65-126

TYPE OF DAM Zoned Earth SIZE Intermediate HAZARD CATEGORY High

DATE(S) INSPECTION 20 June 1979 WEATHER Clear TEMPERATURE 75 @ 1:00 p.m.

POOL ELEVATION AT TIME OF INSPECTION 1458.0 M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL

B. M. Mihalcin

D. L. Bonk

W. J. Veon

OWNER REPRESENTATIVES

PA Fish Commission

E. Smith

D. O'Neill

C. Buell

D. Hyatt

OTHERS

L. Busack - PennDR

RECORDED BY B. M. Mihalcin

EMBANKMENT

PAGE 2 OF 8

ITEM	OBSERVATIONS AND/OR REMARKS	NDI# PA - 457
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical - good. Horizontal - good.	
RIPRAP FAILURES	Riprap spotty along right spillway approach channel wall. Additional riprap required.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.	

EMBANKMENT

PAGE 9 OF 8

ITEM	OBSERVATIONS AND/OR REMARKS	NDI# PA - 457
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Damp area 25 feet wide, 3 to 8 feet below normal pool and located 15 feet to the right of the spillway on the downstream embankment face. Area drained by a 4-inch diameter perforated PVC pipe laid in a trench and covered with crushed stone. Drain discharges into downstream channel immediately below spillway plunge pool.	
ANY NOTICEABLE SEEPAGE	See above. Discharge from drain on the day of the inspection was estimated at approximately 1 GPH.	
STAFF GAGE AND RECORDER	None.	
DRAINS	Toe drains discharging at outlet conduit headwall at approximately 1 GPH.	

OUTLET WORKS

ITEM	OBSERVATIONS AND/OR REMARKS	NDIH PA - 457
INTAKE STRUCTURE	Submerged -- Not observed.	
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Four-foot square reinforced concrete culvert. Several diagonal cracks are located within the interior of the conduit about 10 to 20 feet from the control tower riser.	
OUTLET STRUCTURE	Concrete control tower riser in good condition. No signs of concrete deterioration were observed.	
OUTLET CHANNEL	Unlined trapezoidal-shaped channel. Discharge from the outlet conduit is diverted, along with discharge from the spillway, through a 6½-foot diameter steel conduit that passes beneath township road 880 (Four Mile Run Road) about 350 feet downstream of the embankment.	
GATE(S) AND OPERATIONAL EQUIPMENT	Flow through outlet is controlled via stop logs set in grooves within the control tower riser. A 4-inch diameter cold water tap is used during drought periods. Valve on line closed on the day of the inspection.	

EMERGENCY SPILLWAY

PAGE 5 OF 8

ITEM	OBSERVATIONS AND/OR REMARKS	NDI# PA - 457
TYPE AND CONDITION	Concrete chute with trapezoidal-shaped overflow weir crest in good condition.	
APPROACH CHANNEL	Rock lined channel floor. Riprap spotty along right sidewall of channel.	
SPILLWAY CHANNEL AND SIDEWALLS	Good condition. Several minor cracks were observed the majority of which have been filled and sealed with epoxy.	
STILLING BASIN PLUNGE POOL	Good condition.	
DISCHARGE CHANNEL	Partially lined trapezoidal-shaped channel. Combines with outlet conduit channel immediately below dam (see "Outlet Channel" sheet 4 of 8). Should have more riprap protection.	
BRIDGE AND PIERS	None.	
EMERGENCY GATES	None.	

SERVICE SPILLWAY

PAGE 6 OF 8

NDI# PA - 457

ITEM	OBSERVATIONS AND/OR REMARKS
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

INSTRUMENTATION

PAGE 7 OF 8

NDI# PA - 457

ITEM	OBSERVATIONS AND/OR REMARKS
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

ITEM	OBSERVATIONS AND/OR REMARKS
SLOPES: RESERVOIR	Gentle to moderate slopes comprised about equally of pasture and woodlands.
SEDIMENTATION	None observed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	6-1/2-foot diameter steel pipe culvert passes beneath township road 880 (Four Mile Run Road) about 350 feet downstream of the embankment.
SLOPES: CHANNEL VALLEY	Channel slope moderate surrounded by heavy vegetation. Valley walls steep, generally wooded.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two permanent dwellings are located approximately 2000 feet downstream of the embankment and close to the stream (estimated population ≈ 6 to 8). Several other dwellings are in the same vicinity, but, seem to be sufficiently above the stream as to not appear to contribute to the hazard.

APPENDIX C

HYDROLOGY AND HYDRAULICS

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam; and (2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as outlined below.

- a. Development of an inflow hydrograph(s) to the reservoir.
- b. Routing of the inflow hydrograph(s) through the reservoir.
- c. Development of a failure hydrograph(s) based on specific breach criteria and normal reservoir outflow.
- d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak, and maximum water surface elevation(s) of the failure hydrograph(s) for each location.

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
BY WJV DATE 7-18-79 PROJ. NO. 78-617-457
CHKD. BY DLB DATE 7-27-79 SHEET NO. 1 OF 10



DAM STATISTICS

- HEIGHT OF DAM \approx 32 FT (FIELD MEASURED)
(MEASURED FROM OUTLET INVERT)
- MAXIMUM POOL STORAGE CAPACITY \approx 1650 AC-FT (FROM HEC-1)
@ TOP OF DAM
- NORMAL POOL STORAGE CAPACITY \approx 900 AC-FT (NOTE 1)
- DRAINAGE AREA \approx 5.9 MI²

PLANIMETERED OFF USGS 7.5
MINUTE QUADS: DONEGAL,
SEVEN SPRINGS, MAMMOTH,
AND STAHLSTOWN, PA

NOTE 1: NORMAL POOL STORAGE CAPACITY OBTAINED FROM THE
"REPORT UPON THE APPLICATION OF THE PENNSYLVANIA
FISH COMMISSION [TO CONSTRUCT AND MAINTAIN A
DAM ACROSS FOUR MILE RUN IN DONEGAL TOWNSHIP,
WESTMORELAND COUNTY]" , DATED JUNE 15, 1966, AS FOUND
IN PENNOR FILES.

DAM CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 1, TABLE 1)
(BASED ON MAXIMUM STORAGE)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - PMF (REF 1, TABLE 3)

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
BY WJV DATE 7-18-79 PROJ. NO. 78-617-457
CHKD. BY DLB DATE 7-27-79 SHEET NO. 2 OF 10



HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 3.6 MI

LCA ≈ 1.7 MI (MEASURED ALONG THE LONGEST WATERCOURSE
FROM THE DAM TO THE CENTROID OF THE BASIN)

NOTE 2: VALUES OF L AND LCA ARE MEASURED FROM THE
USGS 7.5 MINUTE STALHSTOWN, SEVEN SPRINGS,
DONEGAL, AND MAMMOTH, PA QUADS. ALL HYDROGRAPH
VARIABLES ARE DEFINED IN REF 2, IN THE SECTION
ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

$$C_t \approx 1.6$$
$$C_p \approx 0.45$$

[SUPPLIED BY COE, ZONE 24]
[OHIO RIVER BASIN]

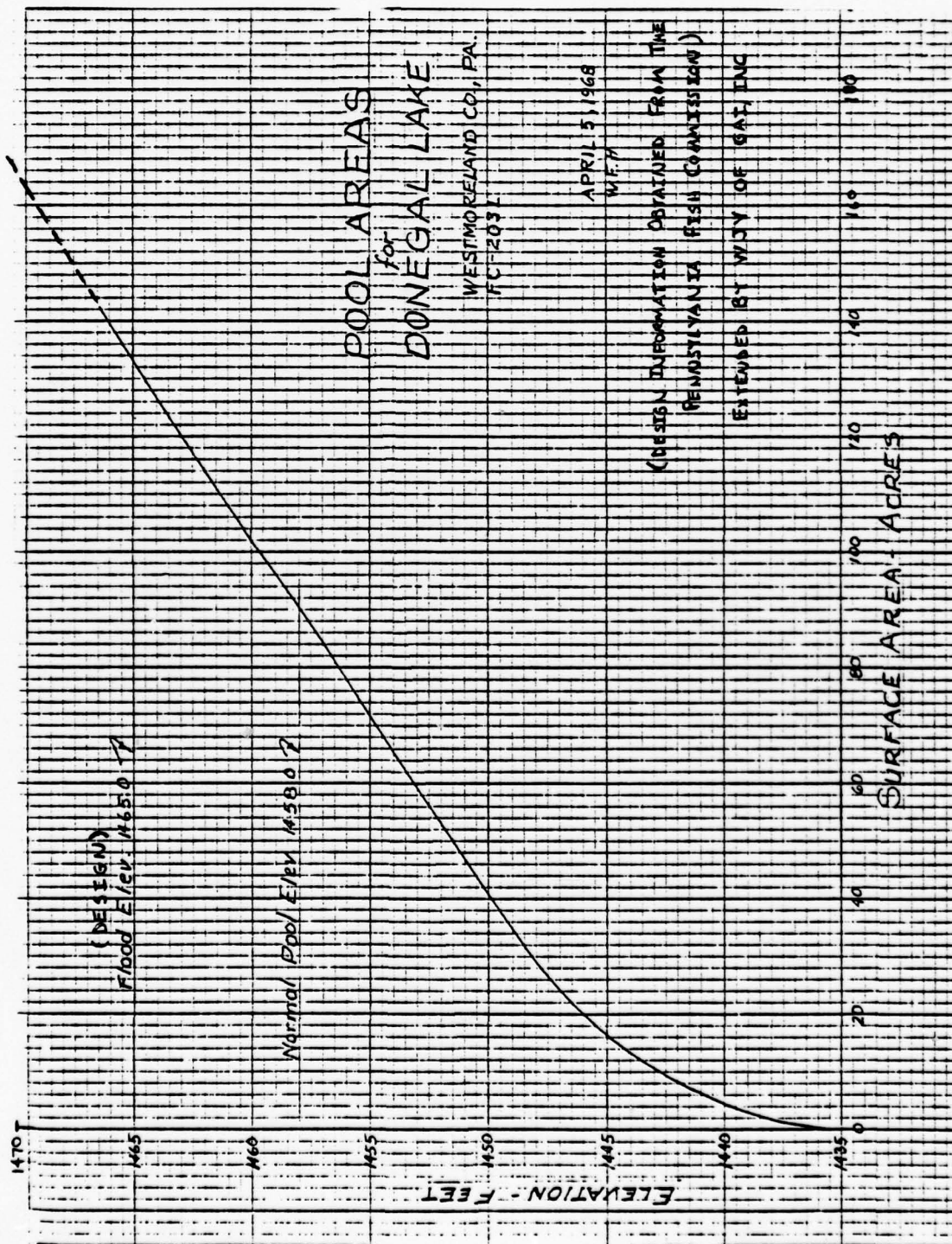
$$t_p = \text{SNYDER'S STANDARD LAG} \approx 1.6 (L \times LCA)^{0.3}$$

$$\therefore t_p \approx 1.6 (3.6 \times 1.7)^{0.3} \approx 2.76 \text{ HR}$$

RESERVOIR ELEVATION - SURFACE AREA RELATIONSHIP

THE ACTUAL DESIGN RELATIONSHIP FOR THE FACILITY
WAS OBTAINED FROM THE PA-FISH COMMISSION. SURFACE
AREA VALUES ABOVE EL 1459.6 (NORMAL POOL ELEVATION)
WILL BE ESTIMATED FROM THE CURVE AND USED IN THE
ANALYSIS. THE RELATIONSHIP IS PROVIDED ON SHEET 3.

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
 BY WJV DATE 7-18-79 PROJ. NO. 78-617-457
 CHKD. BY DLB DATE 7-20-79 SHEET NO. 3 OF 10



SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
BY WJV DATE 7-18-79 PROJ. NO. 78-617-457
CHKD. BY DLB DATE 7-27-79 SHEET NO. 4 OF 10



RESERVOIR ELEVATION @ "0" STORAGE

NORMAL POOL VOLUME $\approx \frac{1}{3} HA \approx 900 \text{ AC-FT}$ (CONIC METHOD)

SURFACE AREA @ NORMAL POOL EL 1458.0 $\approx 90 \text{ AC}$ (SHEET 3)

$$\therefore H \approx (900 \text{ AC-FT}) (3) / (90 \text{ AC}) \approx 30 \text{ FT}$$

ZERO VOLUME ELEVATION $\approx 1458.0 \text{ FT} - 30 \text{ FT} \approx 1428.0 \text{ FT}$

NOTE 3: ALTHOUGH THE ACTUAL MINIMUM RESERVOIR ELEVATION APPEARS TO BE ABOUT 1435 FT, IN ORDER TO CALCULATE AN ELEVATION-STORAGE RELATIONSHIP AND STILL MAINTAIN A STORAGE OF 900 AC-FT @ NORMAL POOL EL 1458.0 THE ABOVE "0" STORAGE ELEVATION MUST BE INPUT INTO THE HEC-1 PROGRAM.

RESERVOIR ELEVATION-STORAGE RELATIONSHIP

COMPUTED INTERNALLY BY THE HEC-1 PROGRAM, BASED ON THE GIVEN ELEVATION VS SURFACE AREA INFORMATION AS PREVIOUSLY PRESENTED. (SEE SUMMARY INPUT/OUTPUT SHEETS).

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
BY WJV DATE 7-18-79 PROJ. NO. 78-617-457
CHKD. BY DLB DATE 7-27-79 SHEET NO. 5 OF 10



PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 IN (REF 3, FIG 1)
(CORRESPONDING TO A DURATION OF 24 HOURS AND AN AREA OF 200 SQ MI IN SOUTHWESTERN PENNSYLVANIA)
- DEPTH-AREA-DURATION ZONE #7 (REF 3, FIG 1)
- DRAINAGE AREA ≈ 5.9 SQ MI \Rightarrow ASSUME THAT DATA CORRESPONDING TO A 10 SQ MI AREA IS REPRESENTATIVE OF THIS BASIN:

DURATION (HR)	PERCENT OF INDEX RAINFALL (%)
6	102
12	120
24	130
48	140

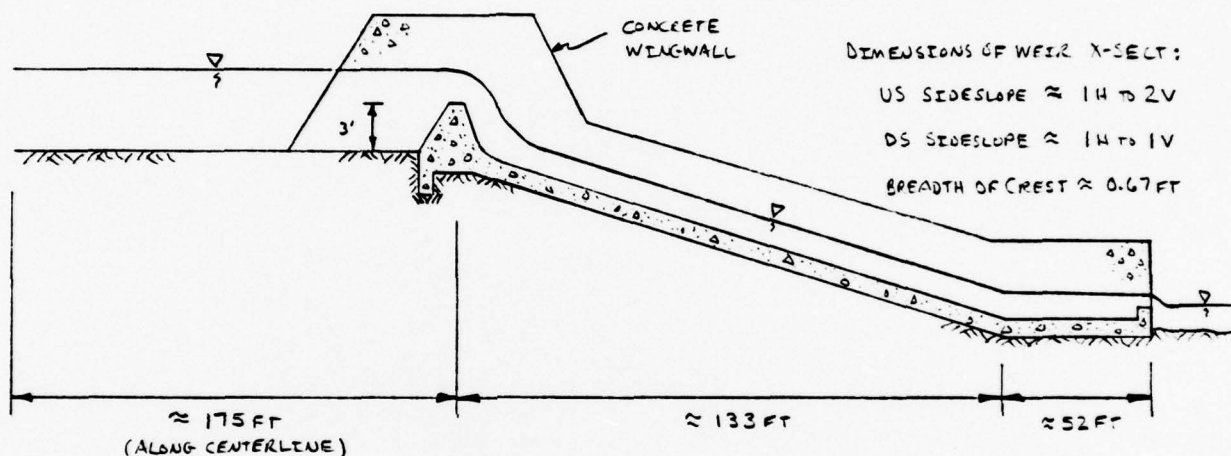
- HOPBROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO A DA ≈ 5.8 SQ MI (< 10 SQ MI) $\Rightarrow 0.80$ (REF 4, PG 48)

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
 BY WJV DATE 7-19-79 PROJ. NO. 78-G17-457
 CHKD. BY DLB DATE 7-27-79 SHEET NO. 6 OF 10

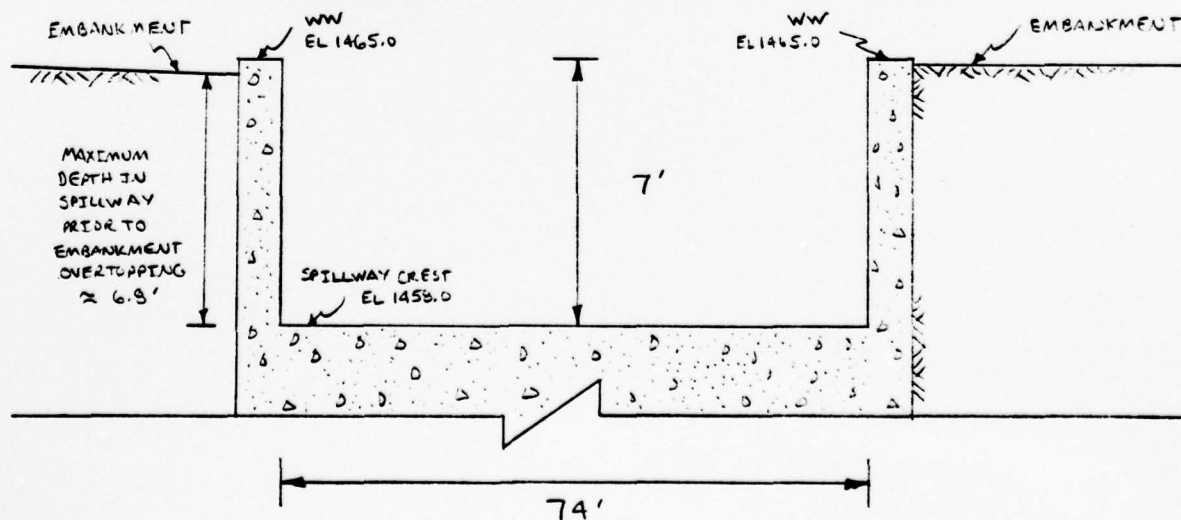
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SPILLWAY CAPACITY

- PROFILE OF SPILLWAY : (NOT TO SCALE)
 (OBTAINED FROM FIELD MEASUREMENT AND OBSERVATION, AND FIGURES IN APPENDIX F)



- CROSS-SECTION OF SPILLWAY : (NOT TO SCALE)
 (OBTAINED FROM FIELD MEASUREMENT AND OBSERVATION, AND FIGURES IN APPENDIX F)



SECTION TAKEN LOOKING UPSTREAM TOWARD SPILLWAY

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
 BY WJV DATE 7-19-79 PROJ. NO. 78-617-457
 CHKD. BY DLB DATE 7-27-79 SHEET NO. 7 OF 10



- THE SPILLWAY IS A CONCRETE CHUTE CHANNEL WITH DISCHARGE CONTROLLED BY A CONCRETE, TRAPEZOIDAL-SHAPED WEIR STRUCTURE. ACCORDING TO REF 5 (PG 5-43) AND TO THE DESIGN CALCULATIONS, A TRAPEZOIDAL-SHAPED WEIR OF THE DIMENSIONS GIVEN ON SHEET 6 AND ON FIGURE 9 COULD HAVE A DESIGN DISCHARGE COEFFICIENT (C_d) OF AT LEAST 3.92. SINCE IT IS FELT THAT AN OGEE-SHAPED WEIR IS THE MOST EFFICIENT TYPE OF WEIR, AND THE DESIGN DISCHARGE COEFFICIENT FOR AN OGEE OF SIMILAR DIMENSIONS IS ABOUT 3.93, RELATIONSHIPS CORRESPONDING TO AN OGEE WEIR WILL BE ASSUMED TO BE REPRESENTATIVE OF THE ACTUAL FLOW RELATIONSHIPS OF THE TRAPEZOIDAL-SHAPED WEIR.
- DISCHARGE OVER THE WEIR CAN BE MODELLED BY THE EQUATION:

$$Q = C L H^{3/2} \quad (\text{REF 4, PG 373})$$

WHERE Q = DISCHARGE IN CFS;
 L = LENGTH OF WEIR CREST = 74 FT;
 H = HEIGHT OF RESERVOIR ABOVE SPILLWAY CREST,
 ASSUME DESIGN HEAD (H_d) \approx 6.8 FT;
 C = DISCHARGE COEFFICIENT \approx f (DESIGN HEAD, ACTUAL HEAD, FOREBAY DEPTH, US WEIR SLOPE, DS AFRON EFFECTS, AND SUBMERGENCE).

- DETERMINATION OF " C " CORRESPONDING TO MAXIMUM DISCHARGE:
 - a) DESIGN $C_d = f(P/H_d = \text{FOREBAY DEPTH} / \text{DESIGN HEAD}) \approx 3\text{ft} / 6.8\text{ft} \approx 0.44$
 - $\Rightarrow C_d \approx 3.77 \quad (\text{REF 4, PG 379})$

SUBJECT

DAM SAFETY INSPECTION

FOUR MILE RUN DAM

BY

WJV

DATE

7-22-79

PROJ. NO.

78-617-457

CHKD. BY

DLB

DATE

7-27-79

SHEET NO.

8

OF 10



- b) ADJUSTMENT FOR SLOPING US FACE \Rightarrow 1 H TO 2 V
 SIDESLOPE ($\approx 26.6^\circ$ TO THE VERTICAL) \Rightarrow
 $C_L \approx 1.015 \times C_0 \approx 1.015 \times 3.77 \approx 3.83$ (REF 4, PG 379)

- c) CONSIDER APPROACH CHANNEL LOSSES :

APPROXIMATE APPROACH CHANNEL WIDTH ≈ 100 FT (FIG 3)

RIGHT SIDE OF APPROACH CHANNEL \Rightarrow 2H TO 1V SS

(THROUGHOUT MOST OF THE REACH ; FIGS 3 AND 6)

LEFT SIDE OF APPROACH CHANNEL (LT WW) \Rightarrow VERTICAL SS

- \therefore @ RESERVOIR EL 1464.8 (LOW TOP OF DAM) THE MAXIMUM
 APPROACH CHANNEL DEPTH = FOREBAY DEPTH + HEAD OVER
 WEIR CREST $\approx 3.0 + 6.8 \approx 9.8$ FT

\Rightarrow AVERAGE APPROACH CHANNEL FLOW AREA = A_a

$$A_a \approx (9.8 \text{ FT} \times 100 \text{ FT}) + \left[\frac{1}{2} (9.8 \text{ FT} \times 2) (9.8 \text{ FT}) \right]$$

$$A_a \approx 1076 \text{ FT}^2$$

INITIAL ESTIMATE OF DISCHARGE @ EL 1464.9 FT

$$Q \approx (3.83)(74 \text{ FT})(6.8 \text{ FT})^{3/2} \approx 5030 \text{ CFS}$$

- \therefore AVERAGE APPROACH CHANNEL VELOCITY $\approx Q/A_a$

$$V_a \approx 5030 \text{ CFS} / 1076 \text{ FT}^2 \approx 4.7 \text{ FPS}$$

\Rightarrow AVERAGE APPROACH VELOCITY HEAD = $h_a \approx V_a^2 / 2g \approx 0.34$

ASSUME THAT THE APPROACH CHANNEL ENTRANCE LOSS
 $\approx 0.1 h_a$ (REF 4, PG 379) $\Rightarrow 0.03$ FT

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
 BY WJV DATE 7-22-79 PROJ. NO. 78-617-457
 CHKD. BY DLB DATE 7-27-79 SHEET NO. 9 OF 10



$$\text{APPROACH CHANNEL FRICTION LOSS} = h_f \approx \left[\frac{v^n}{1.49 R_h^{2/3}} \right]^2 L_c$$

WHERE L_c = AVERAGE APPROACH CHANNEL LENGTH
 ≈ 175 FT (SEE FIG 3)

n = MANNING'S ROUGHNESS COEFFICIENT ≈ 0.04
 (REF 7, PG 112; EXCAVATED CHANNEL W/ COBBLE
 BOTTOM AND CLEAN SIDES)

R_h = HYDRAULIC RADIUS = FLOW AREA / WETTED PERIMETER
 FLOW AREA = $A_a \approx 1076$ FT², RIGHT WALL OF
 APPROACH CHANNEL IS ON A 2H TO 1V SS
 THROUGHOUT MOST OF ITS LENGTH AND VARIES TO
 0 FT HEIGHT @ THE ENTRANCE (FIG 3 AND 6),
 LEFT WINGWALL AVERAGES A 6.7 HEIGHT (FIG 8)
 \Rightarrow WETTED PERIMETER ≈ 100 FT + 6.7 FT + 11 FT
 ≈ 117.7 FT $\Rightarrow R_h \approx 1076 \text{ FT}^2 / 117.7 \text{ FT} \approx 9.1$ FT

$$\therefore h_f \approx (175 \text{ FT}) \left[\frac{(4.7)(0.04)}{(1.49)(9.1)^{2/3}} \right]^2 \approx 0.15 \text{ FT}$$

$$\therefore \text{TOTAL APPROACH LOSS} \approx 0.03 + 0.15 \approx 0.18 \text{ FT}$$

$$\Rightarrow \text{ACTUAL EFFECTIVE HEAD} \approx 6.8 \text{ FT} - 0.18 \text{ FT} \approx 6.62 \text{ FT}$$

d) CONSIDER EFFECTS OF SUBMERGENCE: THE SPILLWAY
 STILLING BASIN IS LOCATED ABOUT 25 FT LOWER THAN
 THE WEIR AT THE END OF THE 17% SLOPING CHUTE
 CHANNEL. THEREFORE, SUBMERGENCE OR APRON EFFECTS
 ARE ASSUMED TO BE NON-EXISTENT.

$$\therefore \text{FINAL } C @ \text{ DESIGN HEAD} \approx 3.93$$

- SPILLWAY CAPACITY:

$$Q = CLH^{3/2} \approx (3.93)(74 \text{ FT})(6.62 \text{ FT})^{3/2} \approx 4830 \text{ CFS}$$

SUBJECT DAM SAFETY INSPECTION
FOUR MILE RUN DAM
 BY WJV DATE 7-23-79 PROJ. NO. 78-617-457
 CHKD. BY DLB DATE 7-27-79 SHEET NO. 10 OF 10



SPILLWAY RATING CURVE

COMPUTED INTERNALLY BY HEC-1 VIA THE OGEE RATING CURVE ROUTINE. THE OGEE ROUTINE COMPUTES DISCHARGES IN A MANNER SIMILAR TO THAT OUTLINED ON SHEETS 7 THROUGH 9. BASIC INPUTS INCLUDE THE DESIGN HEAD (UNCORRECTED FOR APPROACH LOSS) ≈ 6.8 FT, APRON ELEVATION ≈ 1433 FT, APRON WIDTH ≈ 50 FT, APPROACH CHANNEL LOSS @ THE DESIGN HEAD ≈ 0.18 FT, AND FOREBAY DEPTH ≈ 3 FT.

EMBANKMENT RATING CURVE

- COMPUTED INTERNALLY BY HEC-1 VIA THE ASSUMPTION THAT CRITICAL DEPTH ON THE CREST CONTROLS POSSIBLE OVERTOPPING FLOWS. THE CREST PROFILE IS REPRESENTED BY A SERIES OF TRAPEZOIDS (SEE SUMMARY INPUT/OUTPUT SHEETS FOR RATING INFORMATION)
- INPUT INFORMATION : (BASED ON FIELD MEASUREMENTS)

RESERVOIR ELEVATION (FT)	HEIGHT ABOVE CREST (FT)	INUNDATED CREST LENGTH (FT)
1464.9	-	0
1464.9	0.1	5
1465.1	0.3	190
1465.2	0.4	380
1465.6	0.8	420
1467.0	2.2	460
1469.8	4.0	520

} PARTIALLY DUE TO
LEFT ABUTMENT
SLOPE OF SH TO LV



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SUMMARY INPUT/OUTPUT SHEETS

DAM SAFETY INSPECTION *****
 FOUR MILE RUN DAM ***** OVERCUPPING ANALYSIS *****
 15-MINUTE TIME STEP AND 46-HOUR STORM DURATION

[illegible]

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NNTU= 3 LNTU= 1
NTU= .50 1.00

SUB-AREA RUNOFF COMPUTATION

INFLUENCE OF RESEARCH

ISTAU	ICOMP	IECUN	ITAPE	JPLT	JPRF	INAME	ISTAGE	LAUTO
1	0	0	0	0	0	1	0	0

HYDROG		TAKEA		SNAP		HYDROGRAPH DATA	
1	1	1	5.90	0.00	5.90	0.00	TRSDA TRKSPC

PRECIP DATA

```

      SVE  PMS  R6  R12  R24  R48  R72  R96
      0.00  24.00  102.00  120.00  130.00  140.00  0.00  0.00
      INITIAL AND CONSTANT RAINFALL LOSSES
      AS PER COE
  
```

[illegible]

BASE FLOW PARAMETERS
AS PER COE

STRIDE=	-1.50	ORCSWE=	-.95	NTIME=	2.00
---------	-------	---------	------	--------	------

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNIDER CP AND TP ARE TC=11.56 AND RE=17.58 INTERVALS

DATE	HYDROGRAPHIC	EMP.	HR.	PERIOD	ORIGINATOR	AGE	2,78 HOURS, (P=	.25	VOL= 1.00
15.	27.	116.	189.		356.	440.	513.	570.	611.
16.	621.	599.	581.		534.	505.	471.	426.	402.
17.	559.	335.	320.		303.	286.	270.	251.	236.
18.	204.	192.	181.		171.	162.	153.	136.	129.
19.	115.	109.	103.		97.	92.	86.	77.	73.
20.	65.	61.	56.		55.	49.	45.	40.	41.
21.	39.	37.	33.		29.	28.	25.	23.	23.
22.	21.	20.	19.		18.	17.	16.	15.	13.
23.	12.	11.	10.		9.	8.	7.	6.	5.
24.	7.	6.	6.		5.	5.	5.	4.	4.

DAM SAFETY INSPECTION

FOUR MILE RUN DAM

BY WJV

DATE 7-26-79

PROJ. NO. 78-617 - 457

CHKD. BY DLB

DATE 7-26-79

SHEET NO. B OF D



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PMF

0.5 PMF

0.6 PMF

[illegible]

DAM DATA	TUPEL		DAM DATA			
	GOOD	EXPD	DAMMID	DAMMID		
0.	5.	190.	380.	420.	460.	520.
AT OR BELOW ELEVATION	1464.9	1465.1	1465.2	1465.6	1467.0	1468.8

PEAK (UFFL) IS 9575. AT TIME 43.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9575.	7713.	3569.	1285.	370158.
CMS	271.	218.	101.	36.	10482.
14CHS		12.16	22.51	25.32	29.32
MM		308.87	571.65	617.66	617.66
AC-FT		3824.	7078.	7648.	7648.
THOUS CU M		4717.	8731.	9434.	9434.

PTAN 00FL0* IS 4315. AT TIME 44.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	415.	3727.	1774.	642.	169399.
CFS	122.	106.	50.	18.	5237.
INCHES		5.88	11.19	12.15	
AC-FT		149.26	284.10	308.60	
FOCUS CU M		1848.	3518.	3621.	
		2280.	4339.	4713.	

FAN OUTFLOW IS 5221. AT TIME 44.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5221.	4499.	2135.	771.	221976.
CMS	149.	127.	60.	22.	6286.
INCHES		7.09	13.45	14.58	14.58
MM		180.18	341.56	370.40	370.40
AC-FT		2231.	4429.	4586.	4586.
CMHUS CU M		2752.	5217.	5657.	5657.

RESERVOIR

OUTFLOW

HYDROGEN APIS

OVER TOPPING
OCCURS

@ $\approx 0.5\%$ PMF

SUBJECT DAM SAFETY INSPECTION

FOUR MILE RUN DAM

BY WJV

DATE 7-26-79

PROJ. NO. 78-617-457

CHKD. BY DLB

DATE 7-26-79

SHEET NO. D OF D



Engineers • Geologists • Planners
Environmental Specialists

SUMMARY OF DAM SAFETY ANALYSIS

RATIO OF PMF	MAXIMUM RESERVOIR W.S. FEET	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TUF HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1464.32	0.00	1589.	4315.	0.00	44.00	0.00
.60	1465.11	.31	1692.	5221.	2.25	44.00	0.00
.70	1466.65	1.85	1906.	9575.	6.75	43.00	0.00

LIST OF REFERENCES

1. "Recommended Guidelines for Safety Inspection of Dams," prepared by Department of the Army Office of the Chief of Engineers, Washington, D. C. (Appendix D).
2. "Unit Hydrograph Concepts and Calculations," by Corps of Engineers, Baltimore District (L-519).
3. "Seasonal Variation of Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Duration of 6, 12, 24, and 48 Hours," Hydrometeorological Report No. 33, prepared by J. T. Riedel, J. F. Appleby and R. W. Schloemer Hydrologic Service Division Hydrometeorological Section, U. S. Department of the Army, Corps of Engineers, Washington, D. C., April 1956.
4. Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation, Washington, D. C., 1973.
5. Handbook of Hydraulic, H. W. King and E. F. Brater, McGraw-Hill, Inc., New York, 1963.
6. Standard Handbook for Civil Engineers, F. S. Merritt McGraw-Hill, Inc., New York, 1968.
7. Open-Channel Hydraulics, V. T. Chow, McGraw-Hill, Inc., New York, 1959.
8. Weir Experiments, Coefficients, and Formulas, R. E. Horton, Water Supply and Irrigation Paper No. 200, Department of the Interior, United States Geological Survey, Washington, D. C., 1907.
9. "Probable Maximum Precipitation Susquehanna River Drainage Above Harrisburg, Pennsylvania," Hydrometeorological Report 40, prepared by H. V. Goodyear and J. T. Riedel, Hydrometeorological Branch Office of Hydrology, U. S. Weather Bureau, U. S. Department of Commerce, Washington, D. C., May 1965.
10. Flood Hydrograph Package (HEC-1) Dam Safety Version, Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California, July 1978.
11. "Simulation of Flow Through Broad Crest Navigation Dams with Radial Gates," R. W. Schmitt, U. S. Army Corps of Engineers, Pittsburgh District.

12. "Hydraulics of Bridge Waterways," BPR, 1970, Discharge Coefficient Based on Criteria for Embankment Shaped Weirs, Figure 24, page 46.
13. Applied Hydraulics in Engineering, Morris, Henry M. and Wiggert, James N., Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.
14. Standard Mathematical Tables, 21st Edition, The Chemical Rubber Company, 1973, page 15.
15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

APPENDIX D
PHOTOGRAPHS

PHOTOGRAPH 1 View of the embankment as seen from hillside above the right abutment.

PHOTOGRAPH 2 View of the spillway channel looking upstream from just beyond the stilling basin.

PHOTOGRAPH 3 View of the approach area immediately upstream of the spillway crest. Note the lack of slope protection along the earth cut adjacent to the right wingwall.

PHOTOGRAPH 4 View of the spillway overflow crest.



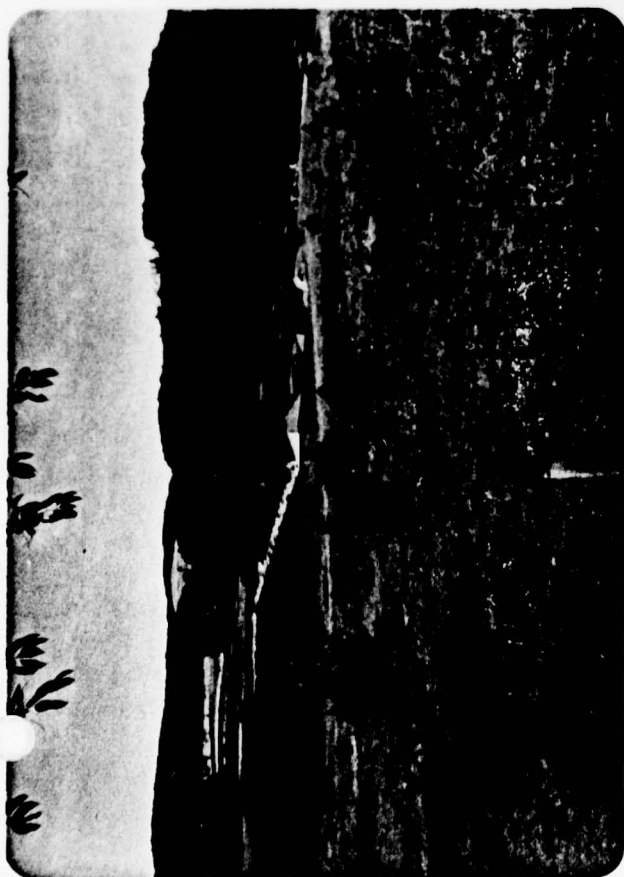
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2



1

PHOTOGRAPH 5 Interior view of the outlet conduit control tower.

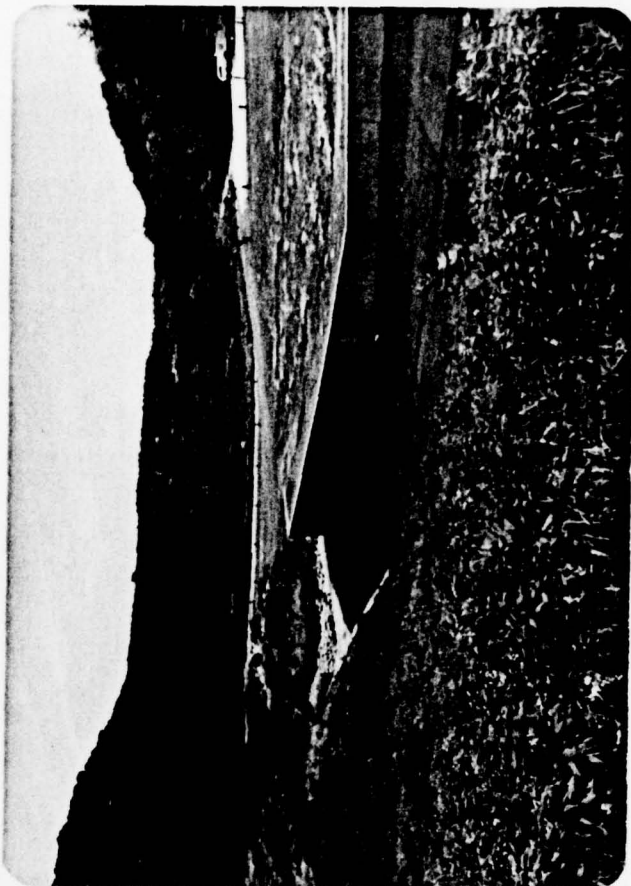
PHOTOGRAPH 6 View of the discharge end of the outlet conduit and the downstream face of the dam.

PHOTOGRAPH 7 View of the reservoir and surrounding slopes.

PHOTOGRAPH 8 View looking downstream from the crest of the dam.



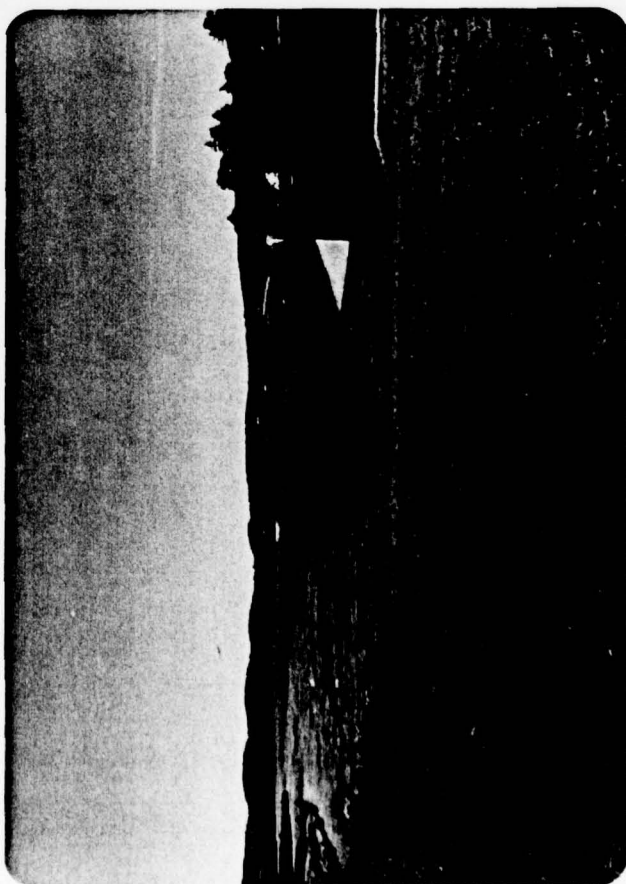
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7

APPENDIX E

GEOLOGY

Geology

Four Mile Run Dam is located approximately 3 miles north-northeast of Donegal within the Allegheny Mountains Section of the Appalachian Plateaus Province. The Allegheny Mountains Section is characterized by gently folded sedimentary rock strata of Pennsylvanian age or older. Major structural axes strike from southwest to northeast with flanking strata generally dipping northwest and southeast.

Structurally, the dam and reservoir lie nearby on the axial trace of the Ligonier syncline. Although the regional dip of the bedrock is in a northwest-southeast direction, the local dip in the immediate vicinity of the dam is controlled by the northeast plunge of the Ligonier syncline. Therefore, the local dip at the dam site to the northeast along the axial trace of the syncline is about 440 feet per mile or 5 degrees.

Bedrock immediately underlying the dam and reservoir is most likely a member of the lowermost portion of the Conemaugh Group. This would include portions of the Mahoning red beds, the Mahoning sandstone and the Upper Freeport coal.

Two workable coal seams underlie the dam and reservoir. The Upper Freeport seam immediately underlies the dam and reservoir and is highly variable in thickness and quality. The Lower Kittanning coal seam is the most persistent seam in the area and, consequently, the most valuable. The latter coal is extensively mined throughout the area although not

in the immediate vicinity of dam. The Lower Kittanning seam lies about 200 feet below drainage at the dam site.

¹Shaffner, Marchant N., "Geology and Mineral Resources of the Donegal Quadrangle, Pennsylvania," Pennsylvania Geologic Survey, Atlas No. 48, 1963.

1967
PHOTOREVISED 1973
AMS 5164 III SE—SERIES V83I

APPENDIX F

FIGURES

LIST OF FIGURES

<u>Figure</u>	<u>Description/Title</u>
1	General Plan - Field Inspection Notes
2	Topography and Location Map
3	Embankment Plan
4	Spillway and Embankment Profile
5	Borings
6	Embankment Sections
7	Outlet Work Details
8	Spillway Plans and Sections
9	Spillway Details

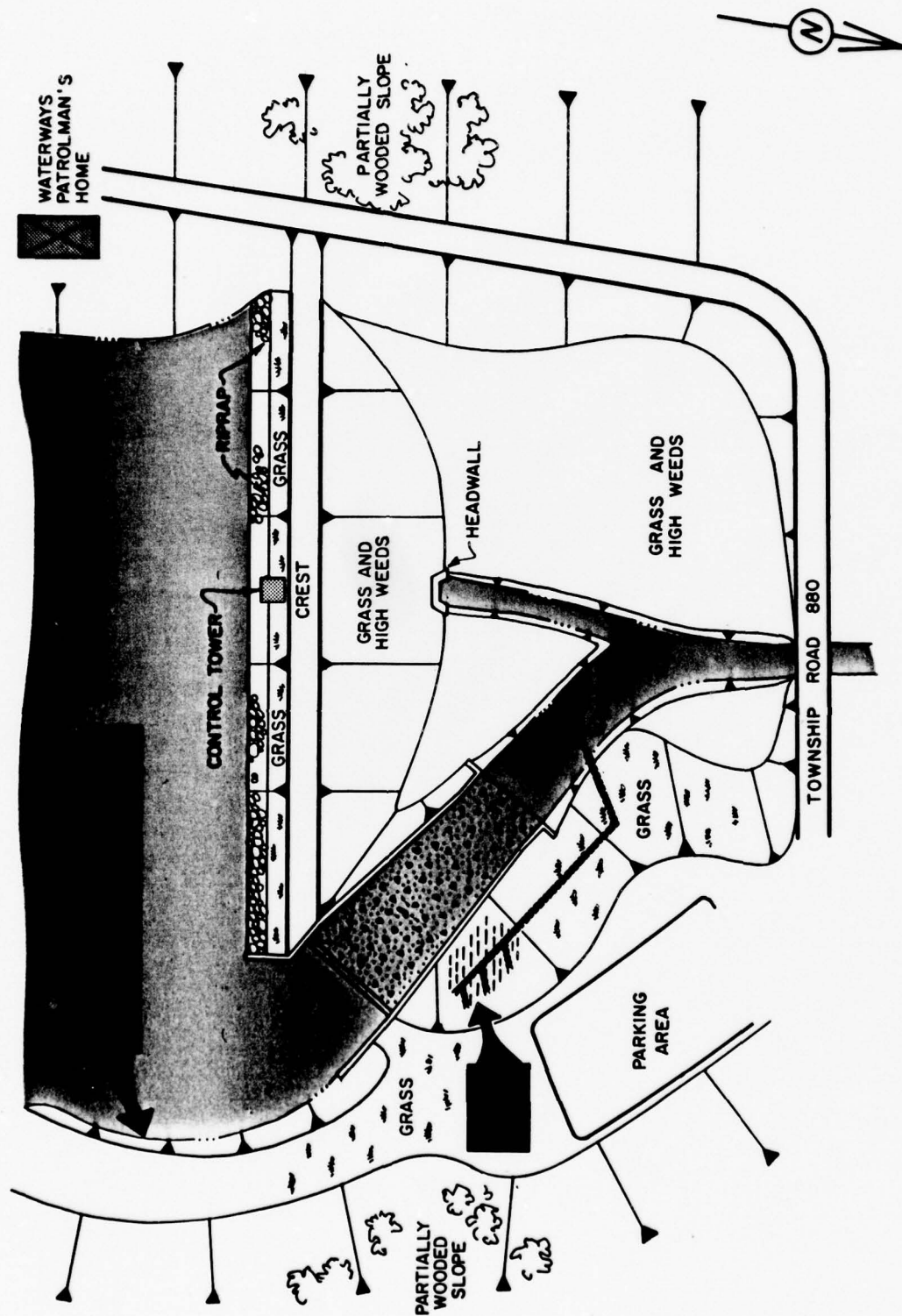
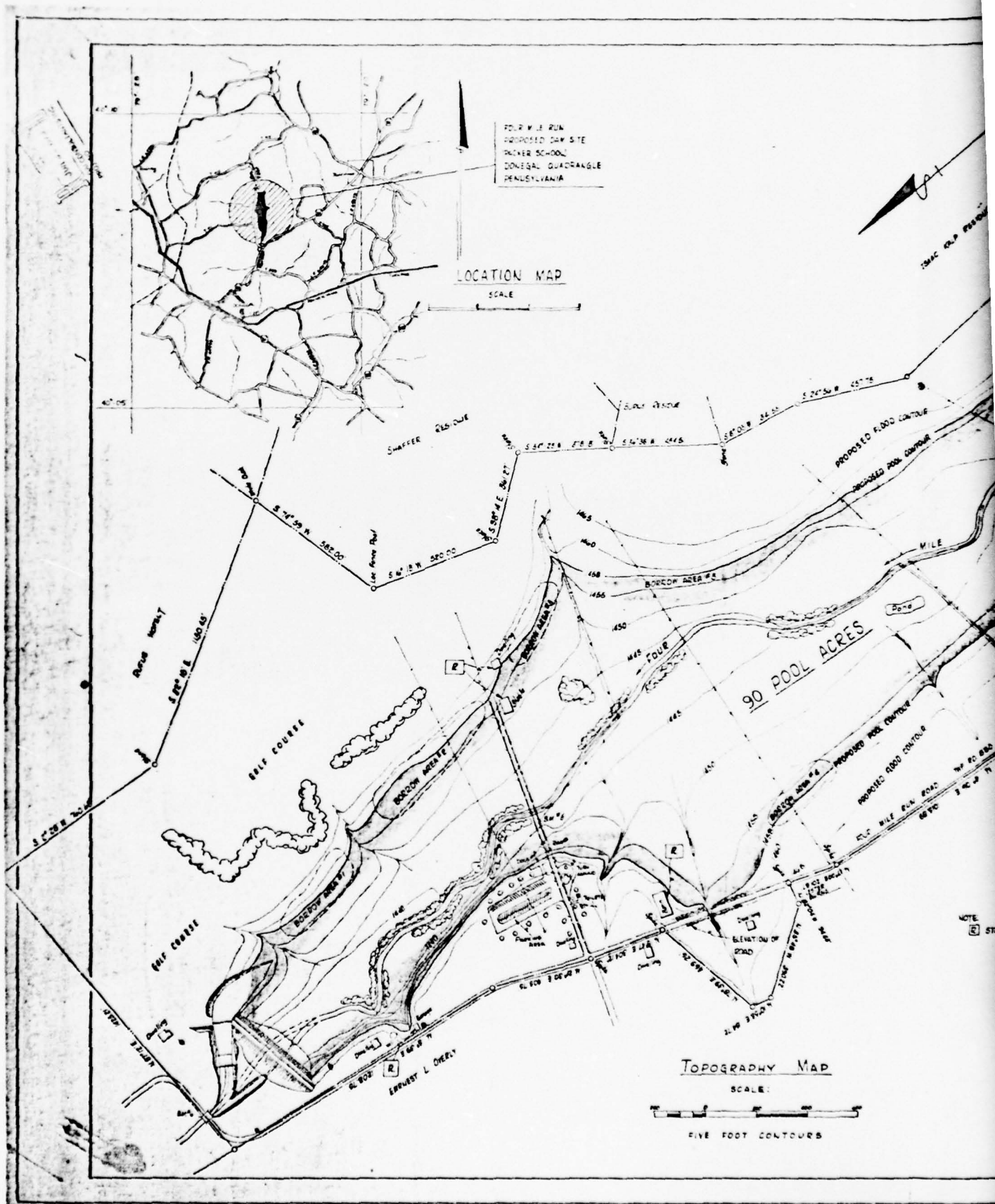


FIGURE 1 - FOUR MILE RUN DAM
GENERAL PLAN : FIELD INSPECTION NOTES






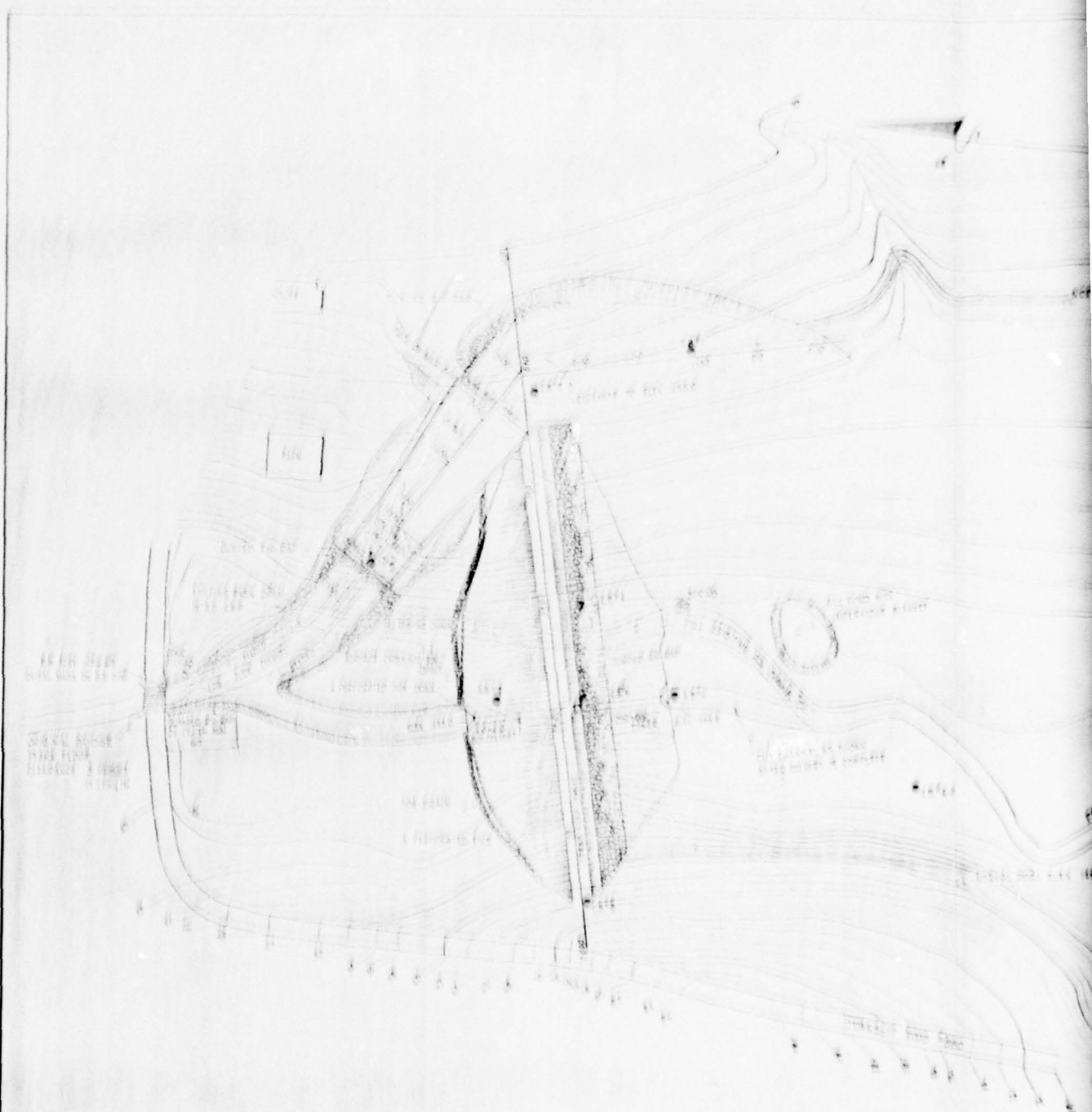
	REVISED	APPROVALS		PROJECT NO. EC-5727-R
	A. J. [] [] []	APPROVED: <i>[Signature]</i> <small>DIRECTOR OF ENGINEERING AND CONSTRUCTION</small> APPROVED: <i>[Signature]</i> <small>CHIEF ENGINEER, BUREAU OF HIGHWAYS & CONSTRUCTION</small> APPROVED AND SEEN: <small>SPECIAL FIELD SUPERVISOR - DIST. DIRECTOR</small> SUBMITTED BY: <i>[Signature]</i> <small>FIELD OFFICE</small> ACCEPTED BY: _____ <small>CONTRACTOR</small> BY: _____ BUREAU OF ENGINEERING & CONSTRUCTION CHECKED ARCH. _____ MECH. _____ ELEC. _____		TOPOGRAPHY & LOCATION MAP FOUR MILE RUN DAM DONELSON TOWNSHIP WESTMORELAND COUNTY PENNSYLVANIA EDWARD A. MILLER - C.E. ENGINEER STATE COLLEGE, PENNSYLVANIA DATE: NOVEMBER 1966 WILLIAM W. SKRANTON, GOVERNOR DEPT. OF PROPERTY & SUPPLIES RICHARD N. MOOREHEAD, SECRETARY HARRISBURG, PENNSYLVANIA SCALE: NOTED

FIGURE 2



ELEVATION PLAN

SCALE
1:100,000

LEGEND

- 100' contour line
- 50' contour line
- 25' contour line
- 12.5' contour line
- 6.25' contour line

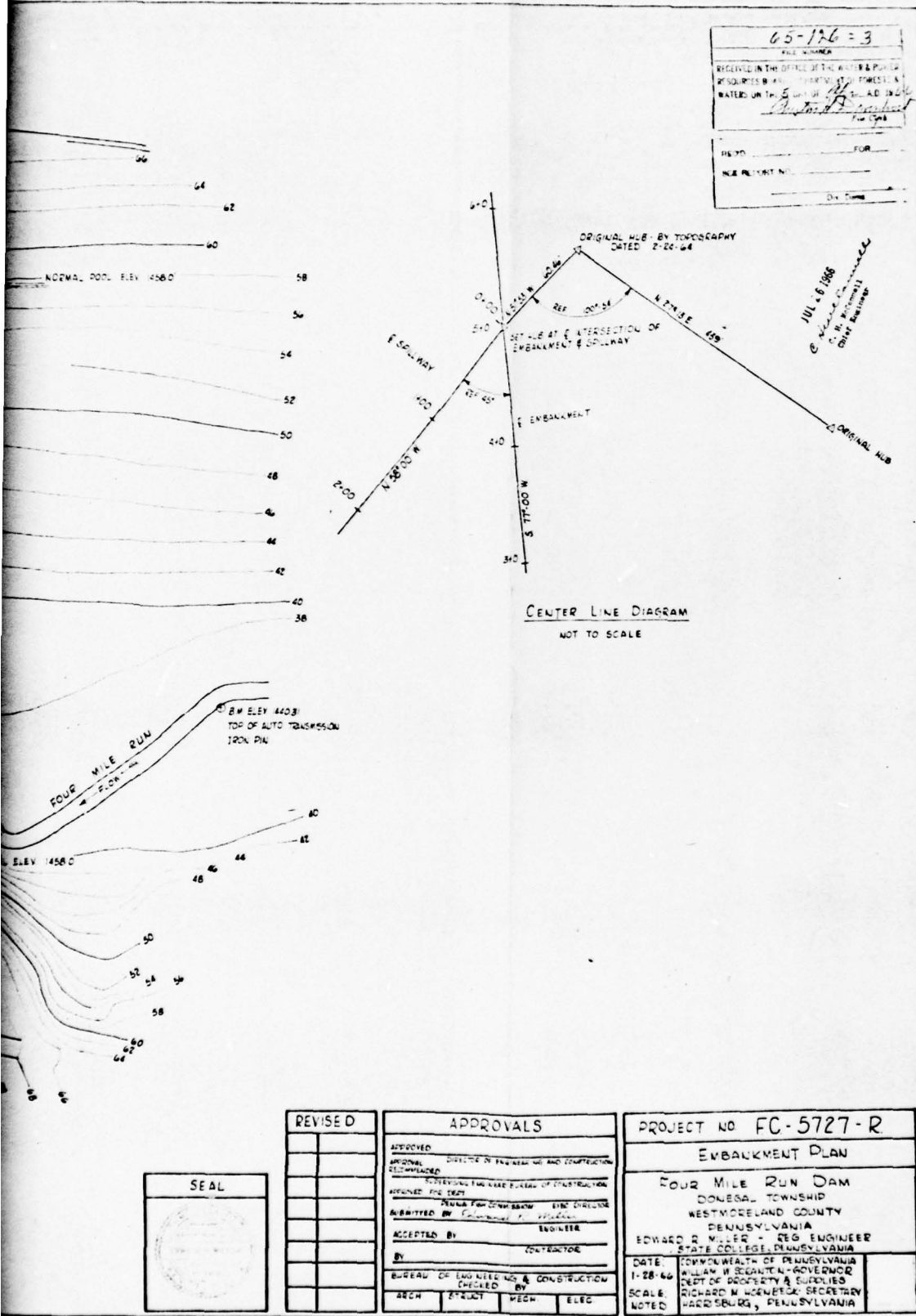
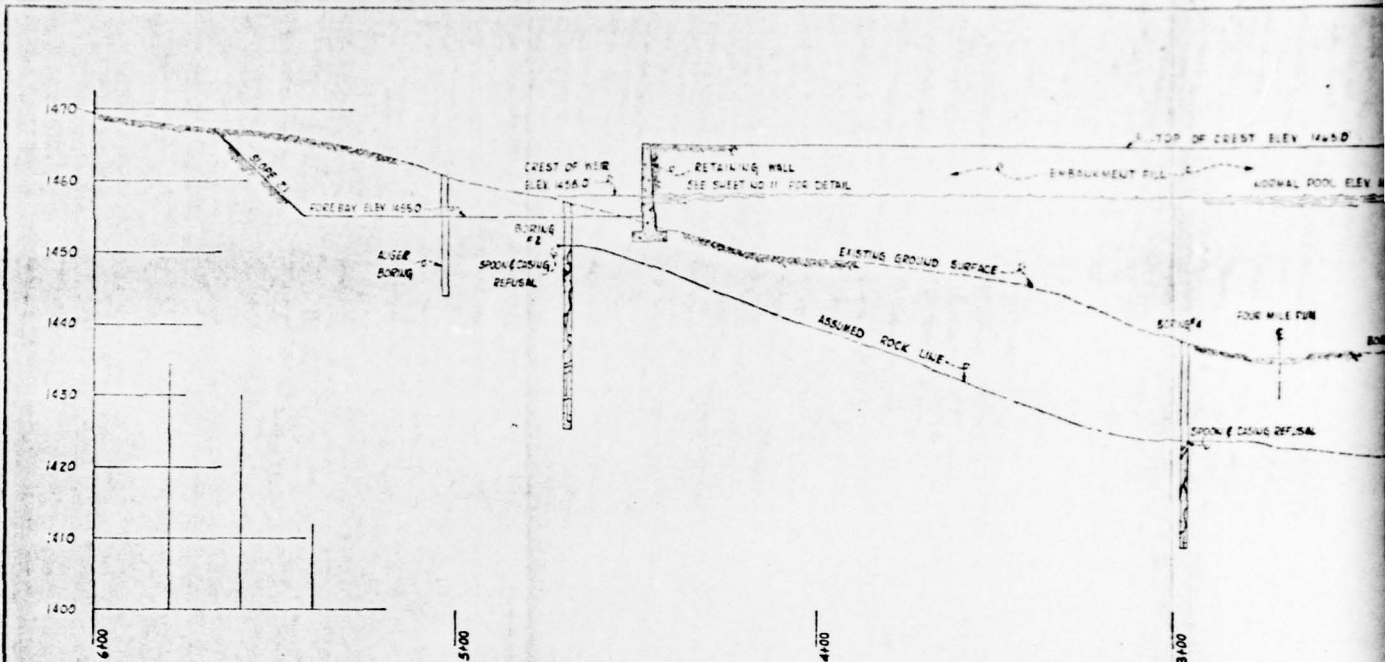
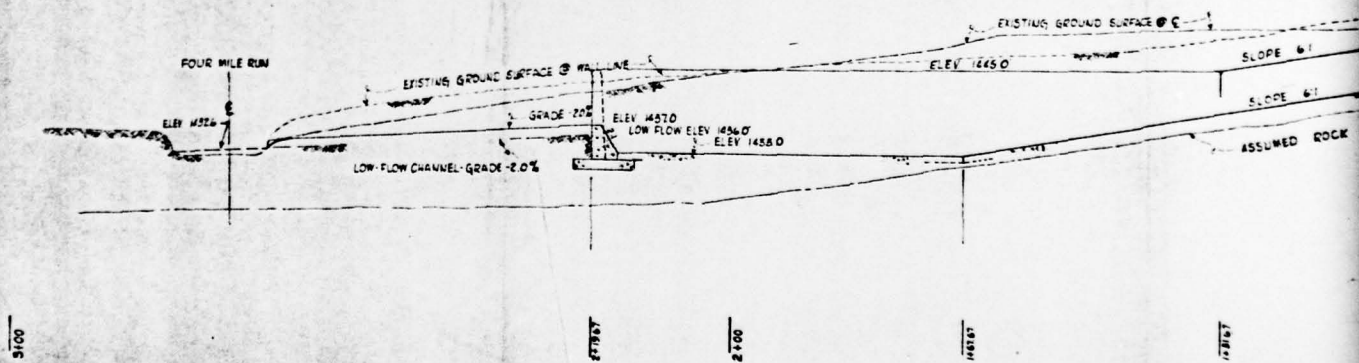


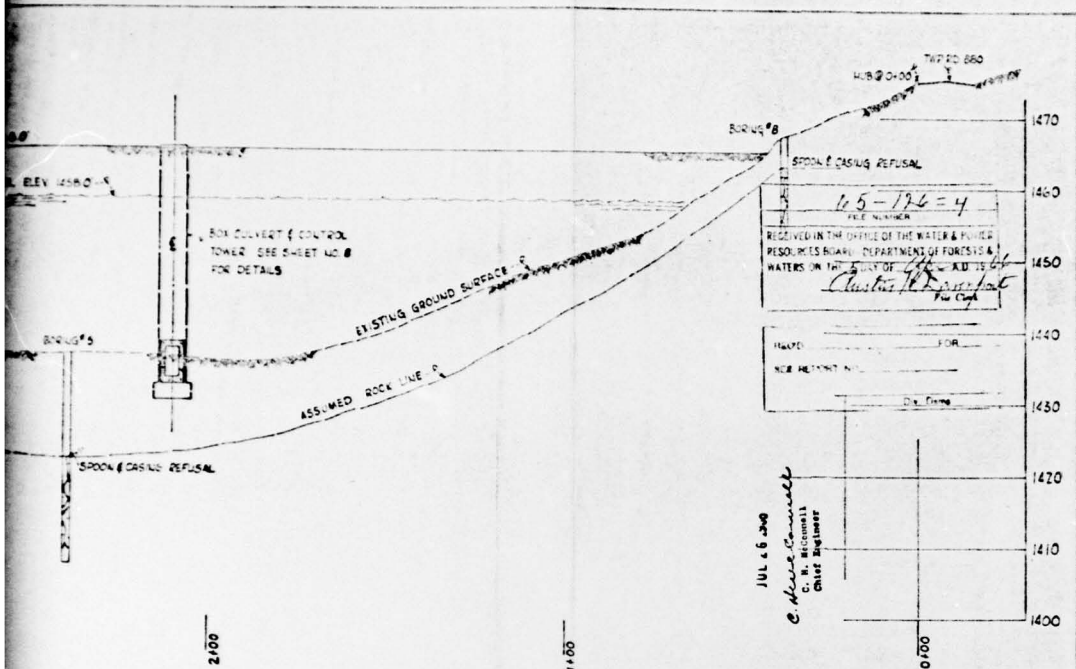
FIGURE 3



EMBANKMENT PROFILE
 1" = 20' HORIZONTAL
 1" = 10' VERTICAL



PROFILE THRU E SPILLWAY & EAST SIDE RETAINING WALL
 1" = 10' HORIZONTAL
 1" = 10' VERTICAL

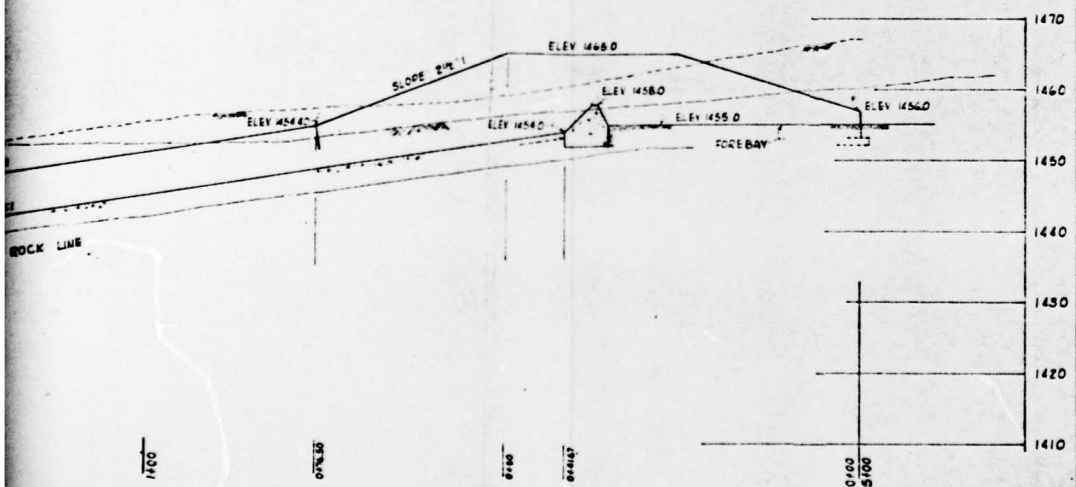


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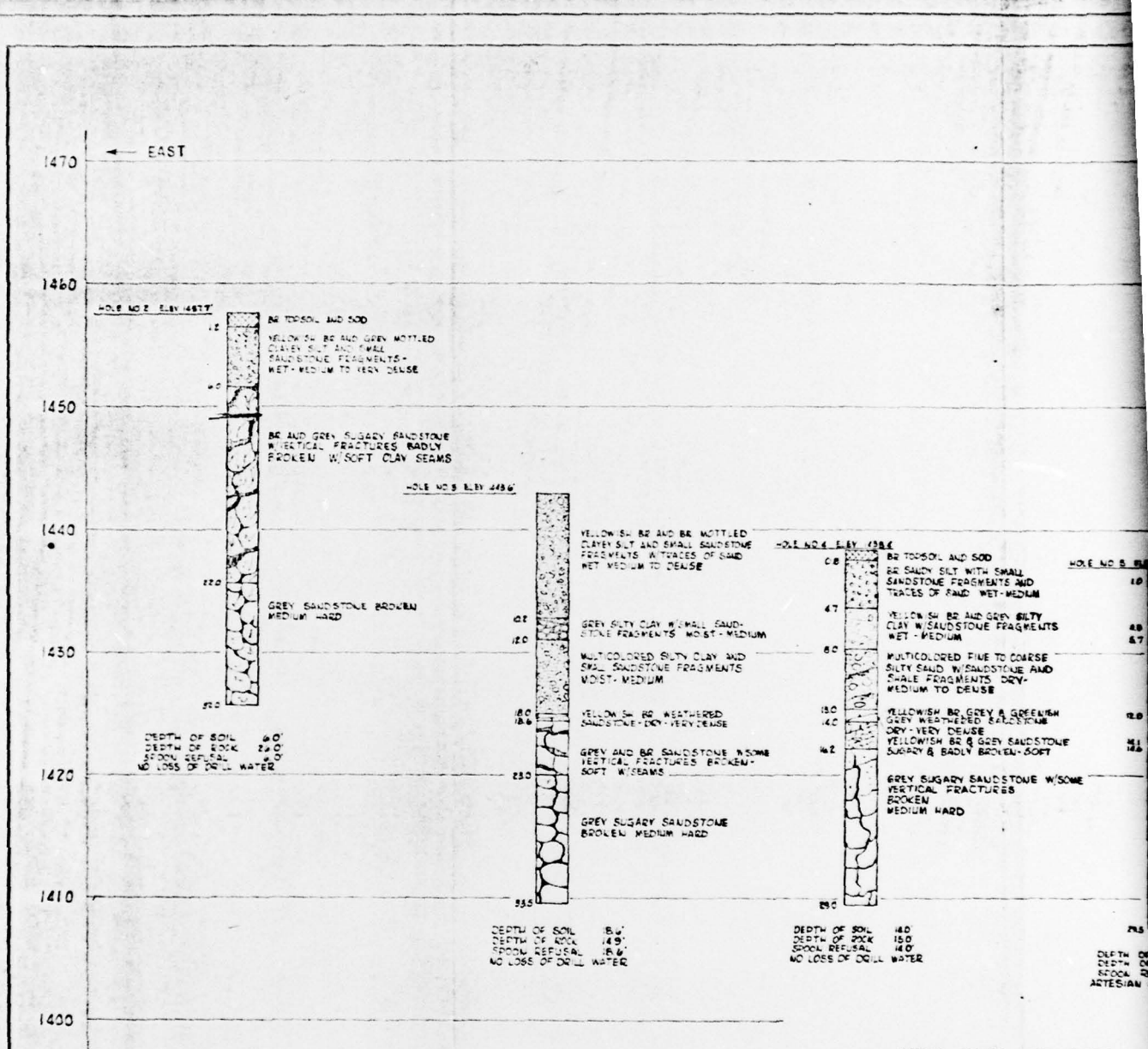
FOR
NEW HEIGHT NO.
DATE

JUL 26 1966
C. H. McConnell
Chief Engineer



SEAL	REVISED	APPROVALS	PROJECT NO FC-5727-R
		APPROVED DIRECTOR OF ENGINEERING AND CONSTRUCTION	SPILLWAY & EMBANKMENT PROFILE
SEAL		APPROVED SUPERVISING ENGINEER, BUREAU OF CONSTRUCTION	FOUR MILE RUN DAM
		APPROVED BUREAU OF CONSTRUCTION	DONEGAL TOWNSHIP
SEAL		APPROVED BUREAU OF CONSTRUCTION	WESTMORELAND COUNTY
		APPROVED BUREAU OF CONSTRUCTION	PENNSYLVANIA
SEAL		APPROVED BUREAU OF CONSTRUCTION	EDWARD R. MILLER - REG. ENGINEER
		APPROVED BUREAU OF CONSTRUCTION	STATE COLLEGE, PENNSYLVANIA
SEAL		APPROVED BUREAU OF CONSTRUCTION	DATE: COMMONWEALTH OF PENNSYLVANIA
		APPROVED BUREAU OF CONSTRUCTION	WILLIAM W. SCRANTON - GOVERNOR
SEAL		APPROVED BUREAU OF CONSTRUCTION	DEPT. OF PROPERTY & SUPPLIES
		APPROVED BUREAU OF CONSTRUCTION	SCALE: RICHARD M. HORNBECK - SECRETARY
SEAL		APPROVED BUREAU OF CONSTRUCTION	NOTED: HARRISBURG, PENNSYLVANIA
		APPROVED BUREAU OF CONSTRUCTION	

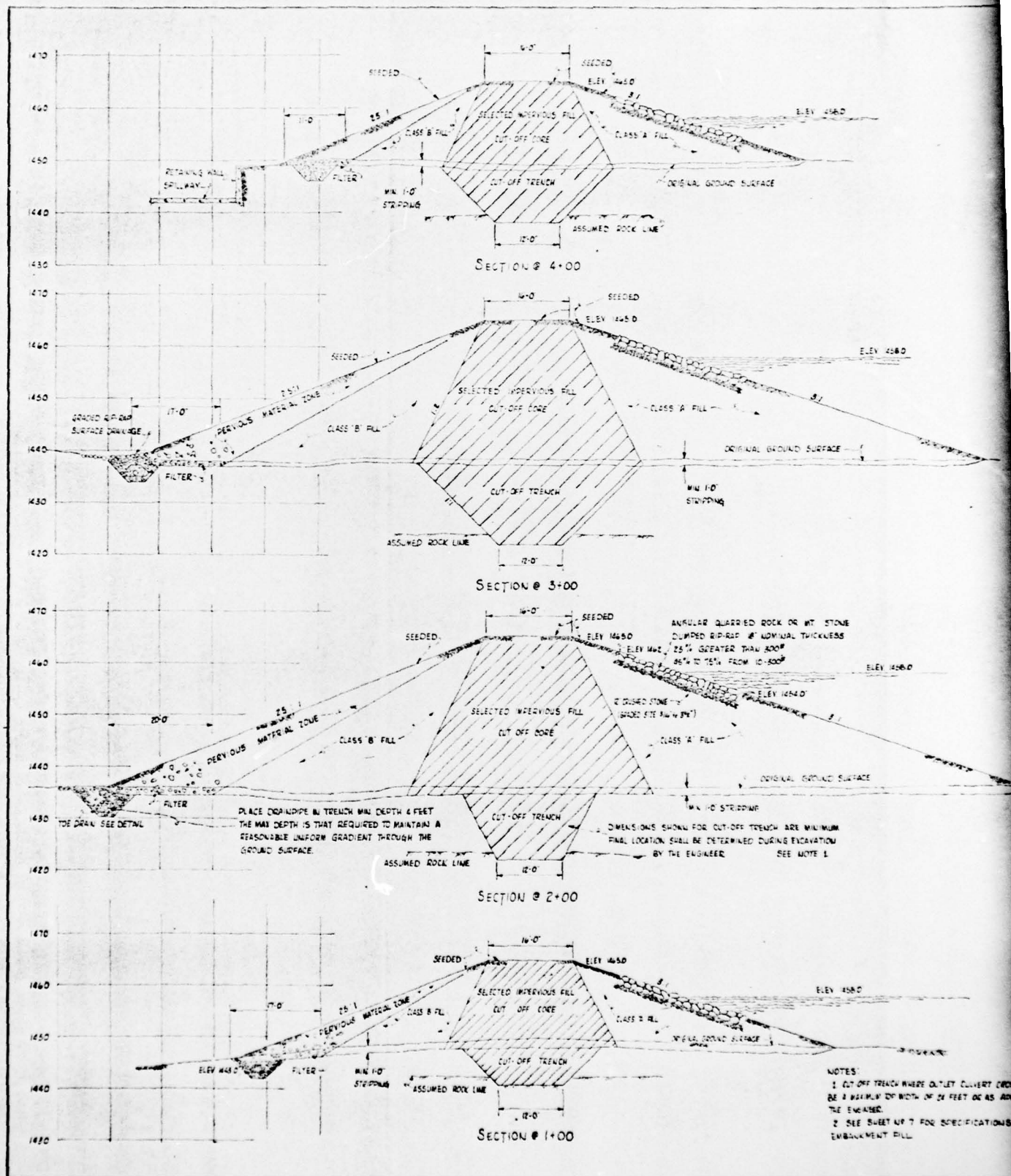
FIGURE 4

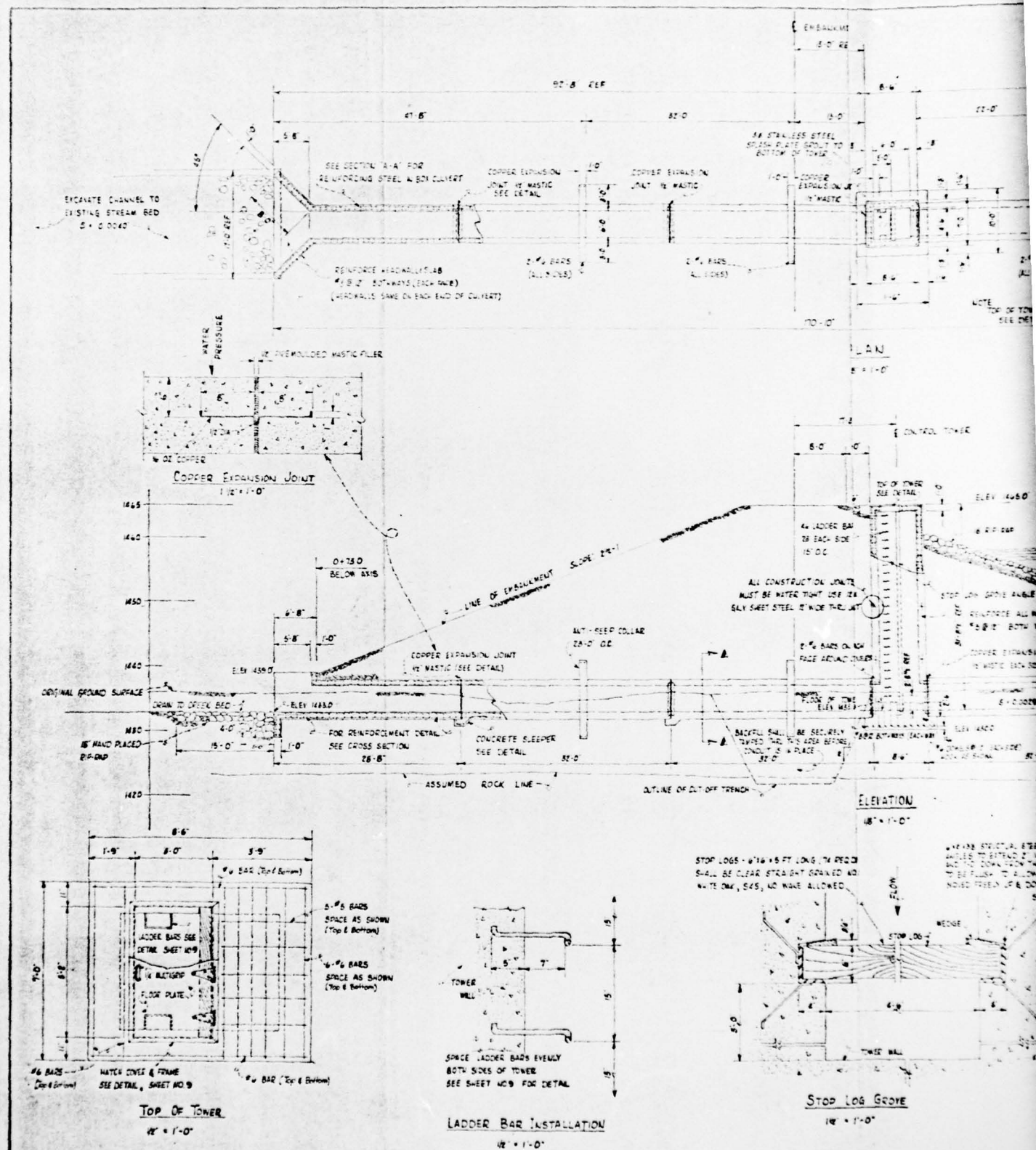


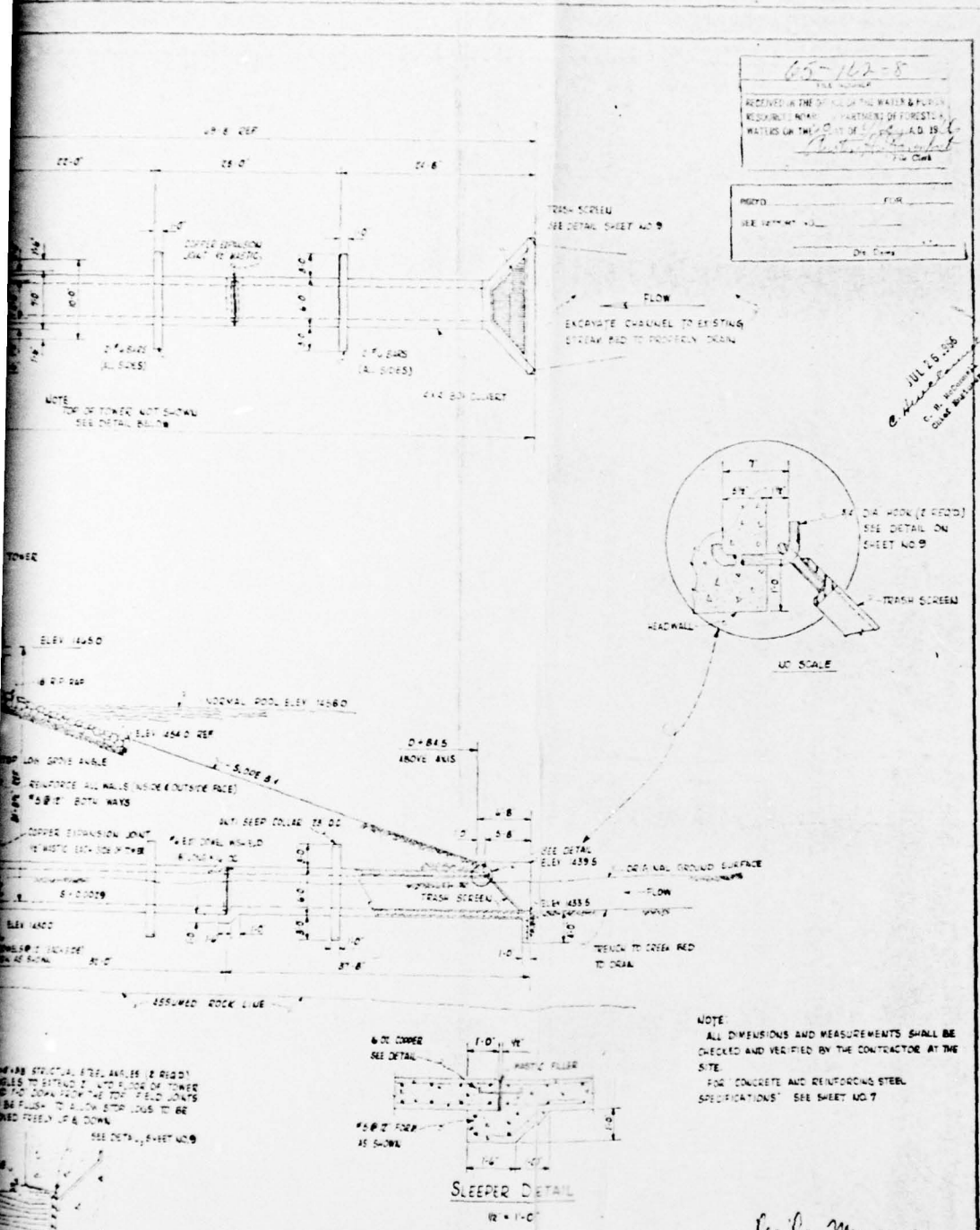
VERTICAL SCALE: 1 INCH = 5 FEET
HORIZONTAL SCALE: NONE

CASING SIZE: 4"
HAMMER WEIGHT: 580# DROP: 18"
SPOON SIZE: 8"
HAMMER WEIGHT: 140# DROP: 30"

DRIVE SAMPLE & CORE BORINGS







65-162-8
FILE NUMBER

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[Signature]

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SEE DETAIL: _____
DATE: _____

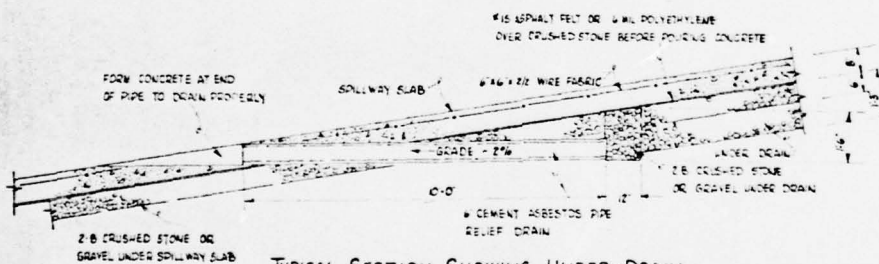
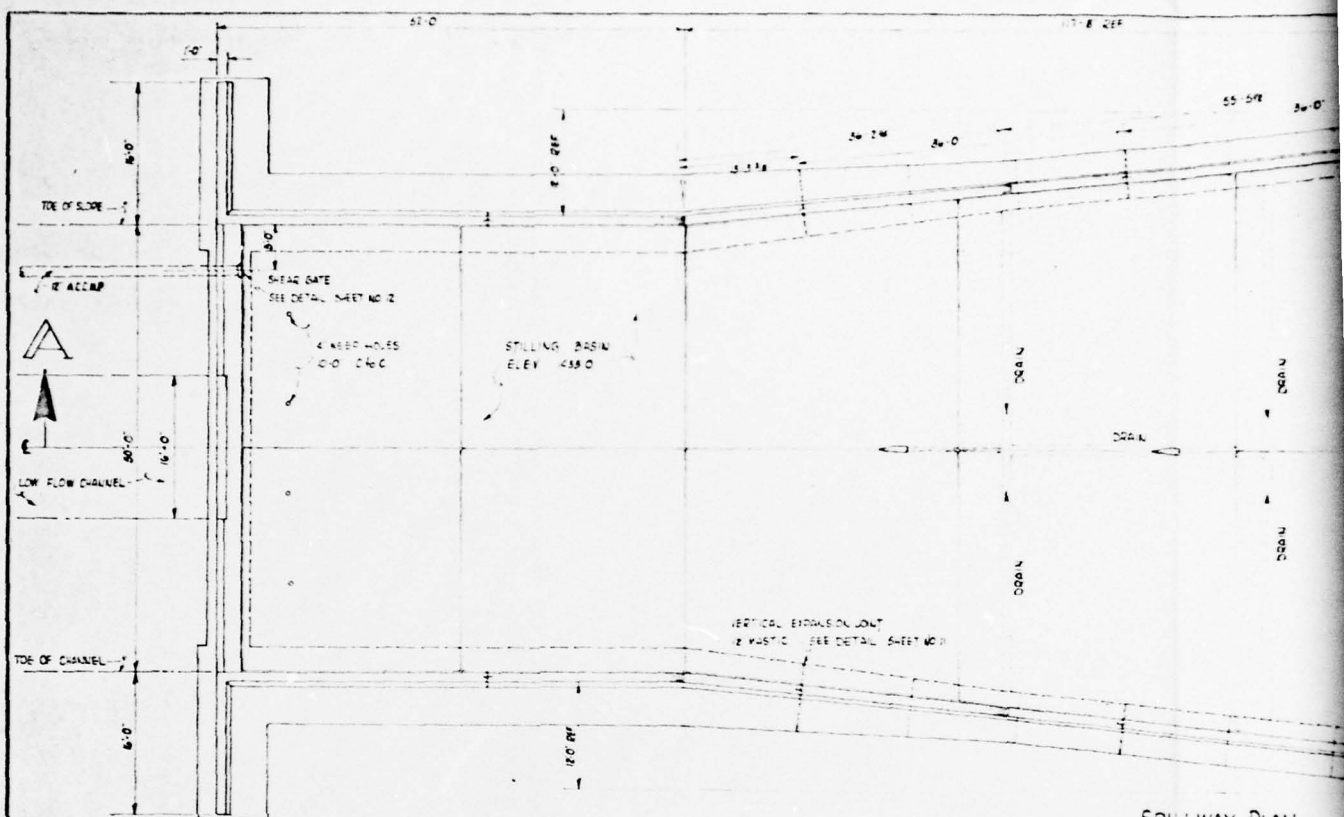
JUL 26 1966
C. R. MILLER
CHIEF ENGINEER

NOTE
ALL DIMENSIONS AND MEASUREMENTS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR AT THE SITE.
FOR CONCRETE AND REINFORCING STEEL SPECIFICATIONS SEE SHEET NO. 7

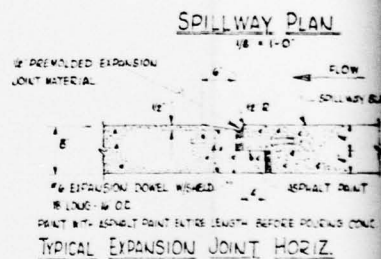
See L. May 20, 1966

<p>SEAL</p>	REVISED	APPROVALS	PROJECT NO FC-5727-R
		<p>APPROVED: [Signature]</p> <p>DESIGNED BY: [Signature]</p> <p>CHECKED BY: [Signature]</p> <p>APPROVED FOR CONSTRUCTION: [Signature]</p>	OUTLET WORK DETAILS
		<p>ACCEPTED BY: [Signature]</p> <p>FOR CONSTRUCTION: [Signature]</p>	<p>FOUR MILE RUN DAM</p> <p>DOONEGAL TOWNSHIP</p> <p>WESTMORELAND COUNTY</p> <p>PENNSYLVANIA</p> <p>EDWARD R. MILLER - REG. ENGINEER</p> <p>STATE COLLEGE, PENNSYLVANIA</p>
		<p>BUREAU OF ENGINEERING & CONSTRUCTION</p> <p>BY: [Signature]</p> <p>ARCH: [Signature]</p> <p>STRUCT: [Signature]</p> <p>PLAN: [Signature]</p> <p>ELEC: [Signature]</p>	<p>DATE: 2-10-66</p> <p>SCALE: NOTED</p> <p>NOTED: COMMONWEALTH OF PENNSYLVANIA WILLIAM W. STEVENSON, GOVERNOR DEPT. OF PROPERTY & SURPLUS RICHARD W. WORTLECK, SECRETARY HARRISBURG, PENNSYLVANIA</p>

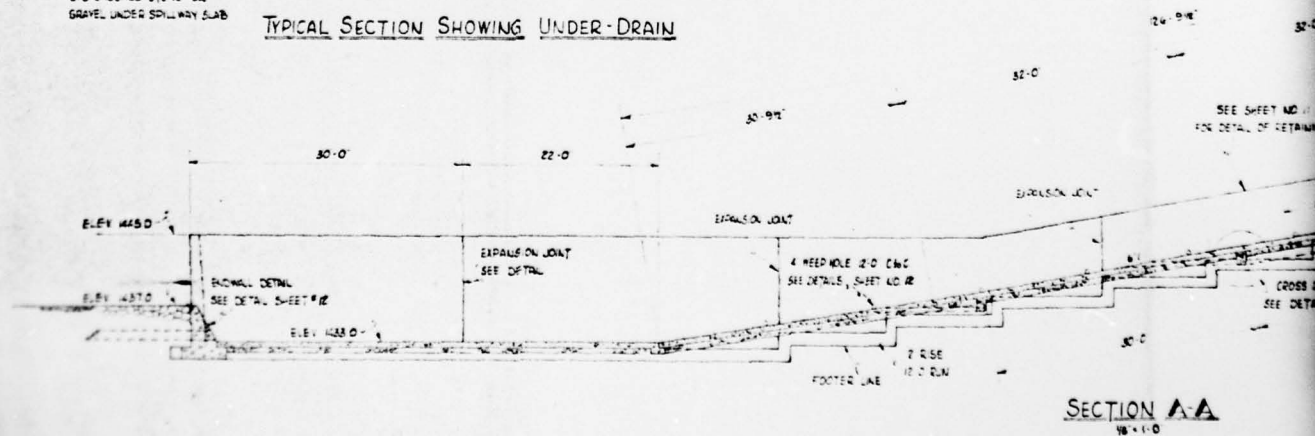
FIGURE 7



TYPICAL SECTION SHOWING UNDER-DRAIN



TYPICAL EXPANSION JOINT HORIZ.



SECTION A-A
1/8" = 1'-0"

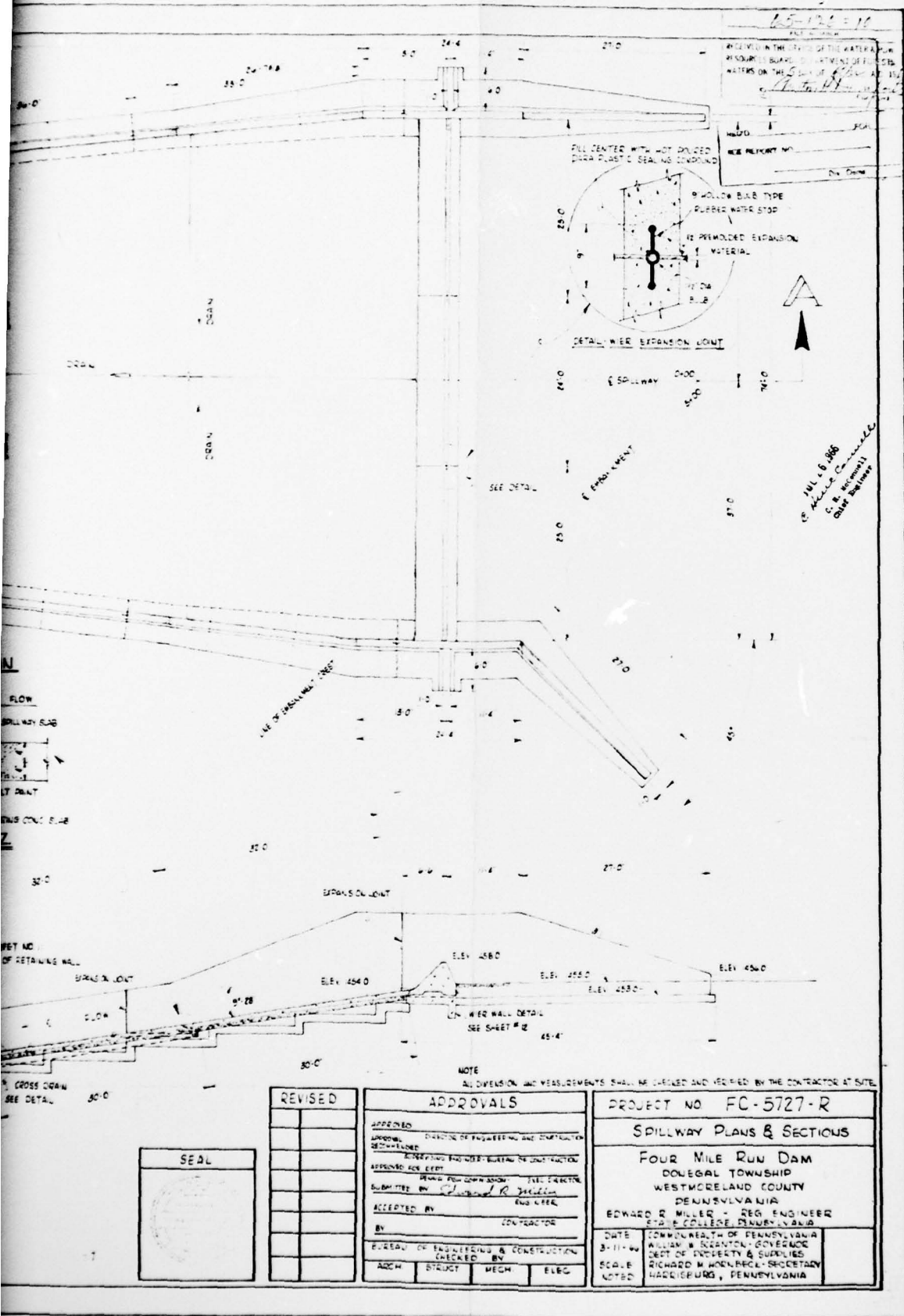


FIGURE 8

65-176-12

FILE NUMBER

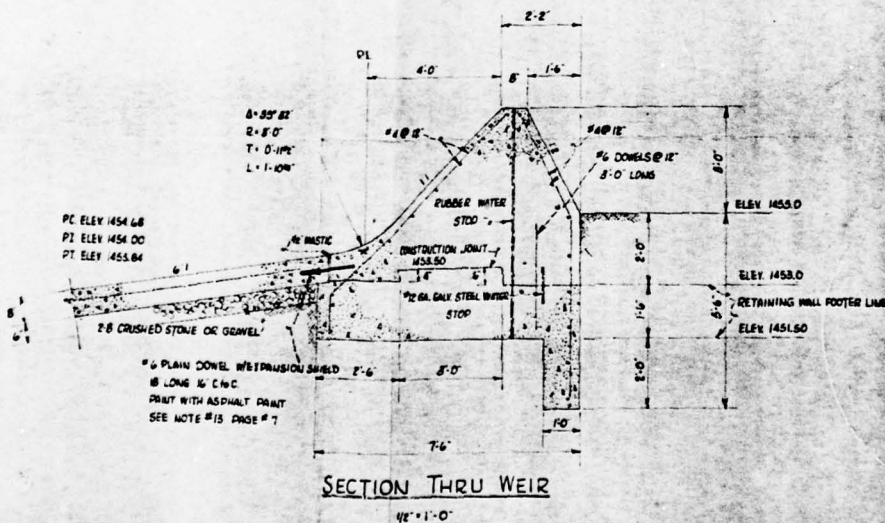
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RESOURCES BOARD - DEPARTMENT OF FORESTS &
WATERS ON THE 1 DAY OF *June* A.D. 1966
Charles H. ...
P.E. 1766

REQD. _____ FOR _____

SEE REPORT NO. _____

Div. _____

JUL 26 1966
C. H. ...
P.E. 1766



NOTE:
ALL DIMENSIONS AND MEASUREMENTS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR AT THE SITE.



REVISED	

APPROVALS			
APPROVED	DIRECTOR OF ENGINEERING AND CONSTRUCTION		
APPROVED	SUPERVISING ENGINEER - BUREAU OF CONSTRUCTION		
APPROVED FOR DEPT.	BUREAU OF CONSTRUCTION		
SUBMITTED BY	ENGINEER		
ACCEPTED BY	CONTRACTOR		
BY	BUREAU OF ENGINEERING & CONSTRUCTION		
CHECKED BY	ARCH. STRUCT. MECH. ELEC.		

PROJECT NO.	EC-5727-R
SPILLWAY & REINFORCING DETAILS	
FOUR MILE RUN DAM DONEGAL TOWNSHIP WESTMORELAND COUNTY PENNSYLVANIA	
EDWARD R. MILLER - REG. ENGINEER STATE COLLEGE, PENNSYLVANIA	
DATE:	3-15-66
SCALE:	NOTED
COMMONWEALTH OF PENNSYLVANIA WILLIAM W. SCRANTON - GOVERNOR DEPT. OF PROPERTY & SUPPLIES RICHARD M. HORNBECK - SECRETARY HARRISBURG, PENNSYLVANIA	

FIGURE 9

APPENDIX G
REGIONAL VICINITY AND WATERSHED BOUNDARY MAP

